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CATHODE-RAY OSCILLOGRAPH

TYPES 340/340-R and 341/341-R

CAL LAB
2-5757

Allen B. Du Mont Laboratories, Inc.
TECHNICAL PRODUCTS DIVISION
760 BLOOMFIELD AVENUE, CLIFTON, N. J., U. S. A.

DUMONT

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ALLEN B. DU MONT LABORATORIES, INC.
TECHNICAL PRODUCTS DIVISION
Clifton, N. J.
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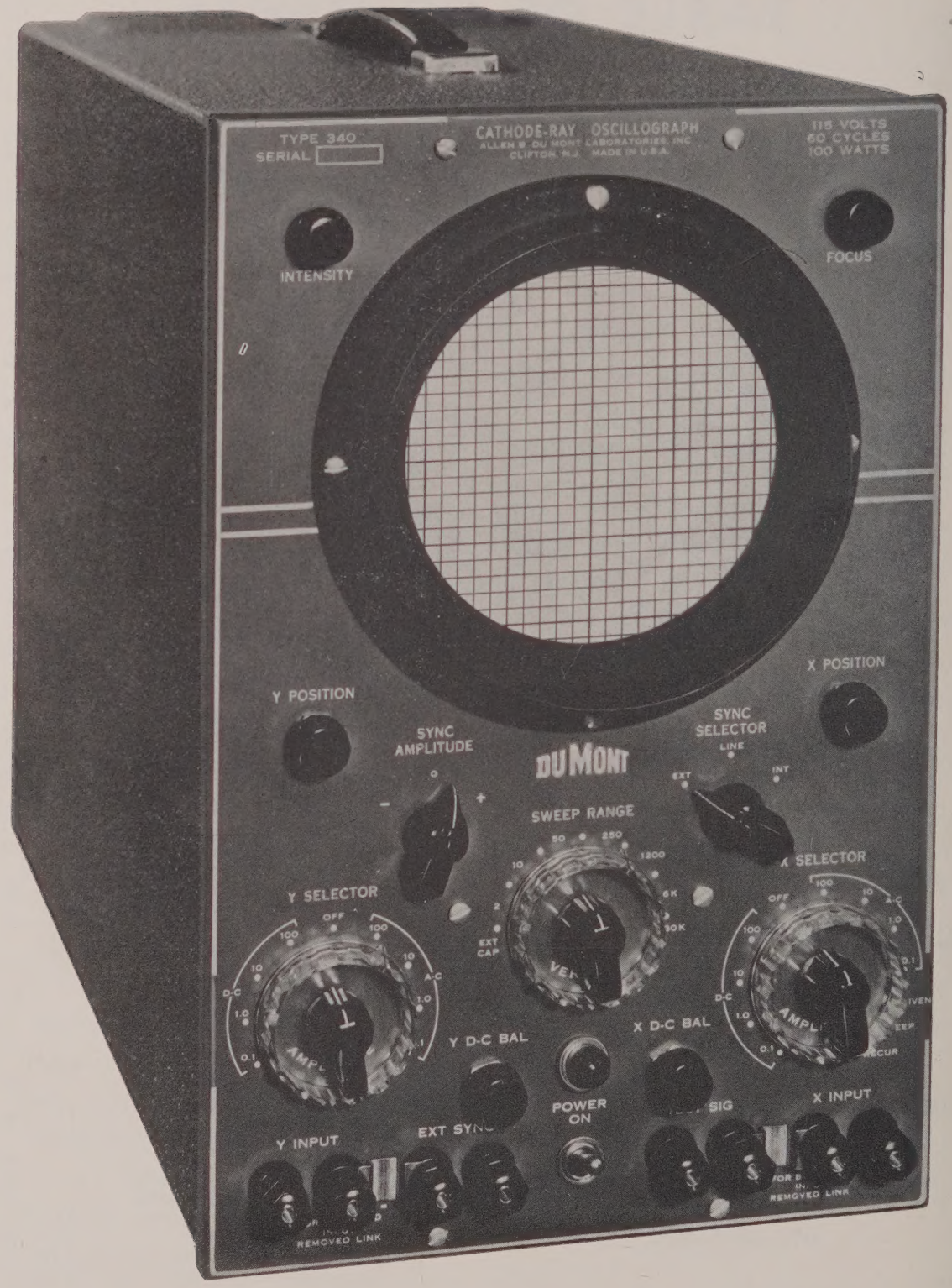


FIGURE 1-1. DU MONT TYPE 340 CATHODE-RAY OSCILLOGRAPH

section 1
technical summary

1. Introduction

This manual of operating and maintenance instructions covers information on the Types 340, 341 Cathode-ray Oscillographs (bench models, and the associate rack-mounted models). Electrically, the -R models are identical to their corresponding counterparts; mechanically, they differ in exterior appearance. These differences are clearly indicated in the text. Otherwise, references throughout the manual to the Type 340 or Type 341 pertain also to the -R models.

2. Purpose

The Du Mont Types 340 and 341 are qualitative instruments, designed to operate over the present wide range of general-purpose oscillography: from very-low speed, mechanical applications to medium-speed single transients encountered with pulse waveforms. The Types 340 and 341 are similar in appearance and electrical design, but differ in that the Type 341 is designed to have greater vertical and horizontal amplifier band width. The high gain of these instruments assures that they can be used directly with many types of transducers, while d-c amplification provides that the lowest frequency portions of signals will be faithfully reproduced.

3. Features

(1) A mono-accelerator type cathode-ray tube with 1500 V over-all accelerating potential.

(2) Provisions for balanced or single-ended vertical input signals.

(3) Provisions for balanced or single-ended horizontal input signals.

(4) Identical frequency response and gain of both X- and Y- amplifiers extending from d-c to 30% down at 100 kc for the Type 340; down 30% at 600 kc for the Type 341.

(5) Sweep ranges from 2 to 30,000 cps.

(6) Provision for connection of external capacitance provided at rear of instrument for extension of low-frequency sweep range.

(7) Driven or recurrent sweep operation with automatic forward trace brightening.

(8) Type 341 only: Co-axial input connectors at rear of instrument for application of A-C or D-C signals to the vertical or horizontal amplifiers without attenuation.

(9) Examination on screen of any portion of signal expanded up to three times full scale without distortion for the Type 340; up to full scale for the Type 341.

(10) Provision for Z-axis (intensity) modulation.

(11) Provision for direct access to the deflection plates of the cathode-ray tube.

(12) Internally regulated transformer provided to achieve nearly complete freedom from line-voltage changes.

(13) Employment of a single etched-wiring board for essentially all of the circuits results in an exceptionally clean, accessible layout.

4. Circuitry Employed

For a general understanding of the electrical circuits incorporated in this oscillograph, refer to the over-all functional block diagram, Figure 1-2. A detailed explanation of the circuit operation will be found in Section III, Theory of Operation.

5. Technical Summary

The electrical and physical characteristics of the Types 340 and 341 are listed in Table 1-1, Technical Summary Sheet, which follows:

TABLE 1-1
TECHNICAL SUMMARY SHEET

CHARACTERISTICS	TYPE 340	TYPE 341
CATHODE-RAY TUBE Type	5AQP–	Same
Total Acceleration Potential	1500 volts	Same

TABLE 1-1 TECHNICAL SUMMARY SHEET (Continued)

CHARACTERISTICS	TYPE 340	TYPE 341
VERTICAL DEFLECTION CIRCUIT		
Input Coupling		
Through Amplifier		
Single-ended signals		
Y INPUT (front panel)	Direct or through capacitor of 600-volt rating	Same
Y INPUT (rear panel)	Not applicable	Direct or through capacitor of 600-volt rating; coaxial connector is available at rear of instrument
Balanced signals	Available at 0.1 D-C position of Y SELECTOR switch	Available at 1.0 D-C position of Y SELECTOR switch
Direct to Deflection Plates	Direct connection can be made when provision is made to maintain an average d-c potential of about 250 volts with respect to ground on the deflection plates	Same
Maximum Input Voltage	600 volts p-p (sum of signal plus d-c)	Same
Input Impedance		
Amplifier		
Single-ended		
Y INPUT (front panel)	2.0 megohms ±5%, 50 μμf max	Same
Y INPUT (rear panel)	Not applicable	2.0 megohms ±5%, 70 μμf max
Balanced	2.0 megohms ±5%, 50 μμf max each side to ground	Same
Direct to Defl Plates		
Single-ended	No greater than 5 megohms (Defl Plate return resistors are not supplied)	Same
Balanced	No greater than 10 megohms center-tapped to ground (Defl-plate return resistors are not supplied)	Same
Deflection Factor		
Amplifier (at full gain)	0.1 volt peak-to-peak full scale or 0.025 peak-to-peak volt/inch (0.0085 rms volt/inch) nominal	0.400 volt p-p full scale; or 0.100 peak-to-peak volt/in. (0.035 rms volt/inch) nominal
Deflection plates	19 to 23 peak-to-peak volts/inch (6.7 to 8.1 rms volts/inch)	Same
Undistorted deflection	At least 4 inches. On-screen portions of expanded pattern, up to 3 times full screen, will have negligible distortion.	At least 4 inches
Sinusoidal Frequency Response (Referred to sensitivity at 1 kc)		
High frequency	Down not more than 30% at 100 kc	Down not more than 30% at 600 kc

TABLE 1-1 TECHNICAL SUMMARY SHEET (Continued)

CHARACTERISTICS	TYPE 340	TYPE 341
Low frequency		
Direct coupled	Flat to d-c	Same
Capacitively coupled		
Y INPUT (front panel)	Down not more than 10% at 2 cycles	Same
Y INPUT (rear panel)	Not applicable	Down not more than 10% at 20 cycles
Pulse Response (to a step function)		
Rise time	3.5 μs or less	0.6 μs or less
Overshoot	2% or less	Same
Decay at top		
Direct coupled		
Y INPUT (front panel)	None	Same
Y INPUT (rear panel)	Not applicable	None
Capacitively coupled		
Y INPUT (front panel)	10% in 21 milliseconds nominal	Same
Y INPUT (rear panel)	Not applicable	10% in 2.1 milliseconds nominal
HORIZONTAL DEFLECTION CIRCUIT (Identical to vertical deflection circuit except as shown)		
Deflection Factor		
Amplifier (at full gain)	0.128 volts peak-to-peak full scale or 0.032 peak-to-peak volt/inch (0.01 rms volt/inch) nominal	0.5 volt peak-to-peak full scale or 0.125 peak-to-peak volt/inch (0.045 rms volt/inch) nominal
Deflection plates	24 to 30 peak-to-peak volts/inch (8.5 to 10.6 rms volts/inch)	Same
X-Y Amplifier Relative Phase Shift Characteristics	See nested table below	Relative phase shift will not exceed 1° below 600 kc with X & Y amplifier gains equalized; less than 3° for any X & Y AMPLITUDE control settings
Linear-sweep Time Base Circuit	Vacuum tube sweep, driven or recurrent as desired	Same
Sweep Frequency		
Internal	Will display one cycle (minimum) of a 2-cycle/sec signal; 30,000 cps (maximum)	Same

(X) & (Y) AMPLITUDE Settings	Relative Phase Shift		
	to 10 kc	to 50 kc	to 100 kc
Maximum	–	<3.5°	–
Any combination	<3.5°	–	<20°
Minimum relative phase shift	–	–	< 1°

section 1
technical summary

TABLE 1-1 TECHNICAL SUMMARY SHEET (Continued)

CHARACTERISTICS	TYPE 340		TYPE 341
External	EXT CAP connector is provided (rear panel) for slower sweeps. For each microfarad of external capacitance approximately 5 seconds of sweep time is secured.		Same
Sweep Expansion	20 inches maximum		Full screen maximum
Horizontal Positioning	Sufficient to position any full scale portion of the expanded sweep or X INPUT signal may be examined on the screen		Sufficient to position full scale X INPUT signal on screen
Sweep Linearity	Any 10% increment is within 10% of any other 10% increment except for the top half of the highest sweep range where the linearity may degrade to 20%		Same
Sweep Beam Gate	Automatic beam brightening during forward sweep. Beam is not visible during sweep retrace or while sweep is at rest. INTENSITY control overrides blanking for X amplifier use. Gate is not disabled when using X amplifier for external signals as long as sweep is not disabled		Same
Synchronization			
Sources	Positive or negative INTernal, power LINE, or EXTernal signals		Same
Sync Sensitivities	DRIVEN SWEEP will trigger on		Same
	INTernal Sync	EXTernal Sync	
Sawtooth signal	Slope greater than 6 in/sec	Slope greater than 60V/sec	
Pulse Signal	0.4 inch of vertical deflection minimum	4 volts; duration greater than 0.2 μs	
Sine Wave signal 3 cycles to 100 kc	0.4 inch of vertical deflection minimum	4 volts p–p minimum	
Up to 250 kc	Greater than 0.4 inch of vertical deflection	Greater than 4 volts p–p	
Up to 500 kc (RECUR SWEEP only)	Recurrent sweep can be synchronized internally with 0.4 inch or greater of vertical deflection, or externally with 4 volts p-p		

TABLE 1-1 TECHNICAL SUMMARY SHEET (Continued)

CHARACTERISTICS	TYPE 340	TYPE 341
INTENSITY MODULATION CIRCUIT		
Availability	Plug on rear panel	Same
Input Impedance	30,000 ohms, 30 μμf	Same
Polarity	Positive signals decrease beam intensity	Same
TEST SIGNAL		
Availability	Front-panel terminal	Same
Amplitude	Sufficient for full-screen deflection	Same
Frequency	Power line	Same
POWER REQUIREMENTS (Includes self-regulating transformer)		
Primary-power Potential	115 volts ± 10%, single phase	Same
*Primary-power Frequency	60 cycles only	Same
Primary Power	100 watts	Same
Fuse Protection		
Primary fuse	2 amperes	Same
Secondary fuses		
LV power supply	0.15 ampere	Same
Heaters	6.25 amperes	Same

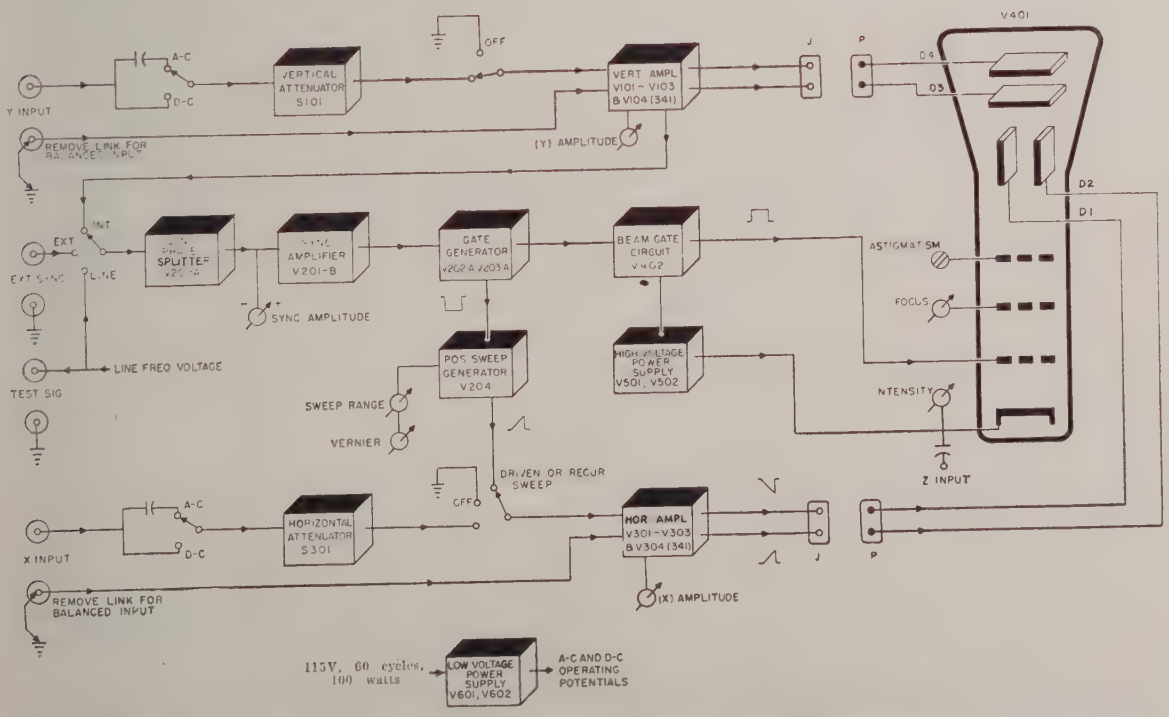
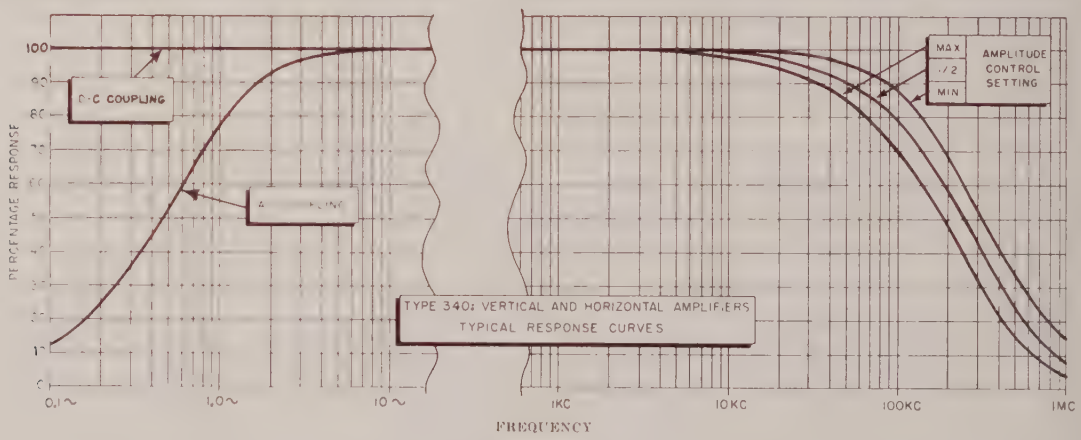


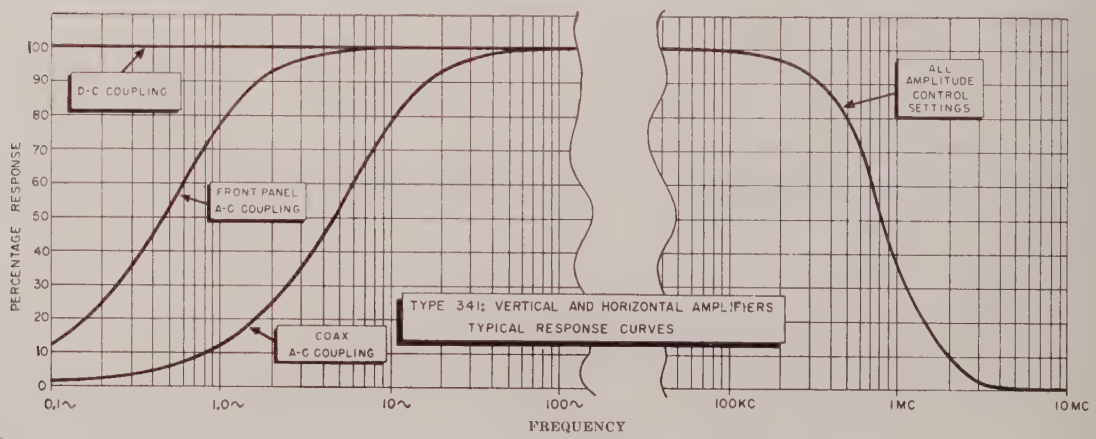
FIGURE 1-2. OVER-ALL FUNCTIONAL BLOCK DIAGRAM TYPE 340/341 CATHODE-RAY OSCILLOGRAPH

section 1
technical summary

TABLE 1-1 TECHNICAL SUMMARY SHEET (Continued)

CHARACTERISTICS	TYPE 340		TYPE 341
	Type 340	Type 340-R	
PHYSICAL CHARACTERISTICS			
Height	13¾ inches	8¾ inches	Types 341 and 341-R dimensions are same as 340 and 340-R respectively
Width	9 inches	19 inches	
Depth	18¾ inches	18¾ inches	
Weight	approx. 40 pounds	same	
*A unit with a non-regulating transformer for use from 50 to 400 cycles with reduced stability will also be available.			
TUBE COMPLEMENT			
Quantity and Type	1–0A2 1–1X2A 1–5AQP– 1–5Y3–GT 1–6AQ5	2–6BK7–A 2–6U8 1–12AT7 5–12AU7 1–12AX7	Same except as follows: 7–12AU7
Total Number	16		18





section 2
operation

1. Unpacking, Inspection and Installation

The Du Mont Types 340 and 341 Cathode-ray Oscillographs are shipped with all tubes in place and ready to operate. Upon receipt, and prior to operation, the Type 340 or 341 should be inspected for any damage incurred in shipment. To remove the instrument from its cabinet, remove the two screws at the back of the cabinet and slide the instrument forward, taking care that the line cord is free to slide through the hole provided. For the –R models, in addition to the rear screws, remove the four outermost front-panel screws located at the top and bottom center, and the left and right center. Slide the instrument forward while observing the previously mentioned precaution.

Since the Types 340 and 341 are portable test instruments, no special installation procedure is required. The –R models have a front panel 19 inches wide by 8¾ inches high for mounting the instrument in a standard relay rack or cabinet.

Normally the Type 340 or 341 may be placed where most convenient for viewing while at the same time maintaining short signal leads. Although shielding has been provided, operation in very strong magnetic fields may cause spurious deflections and should be avoided. Reorientation or additional shielding of the instrument may be necessary to minimize the effects of such fields.

The power transformers in these instruments are intended for operation from a 100–130 V 60-cycle power source only. A variation of 1% in the line frequency will change the secondary voltages delivered by the transformer by about 2%.

Warning

Potentials as high as 1500 volts are employed in these instruments. Such voltages are extremely dangerous; and every possible safety precaution should be taken to avoid contact with them. The instrument is not a hazard when completely enclosed in its cabinet or dust cover. It should not be operated with the cabinet or dust cover removed except for purposes of adjustment or repair, at which time precautions should be taken as described in Section 4, Maintenance.

2. Front-Panel Facilities (See Figure 2-1)

The front-panel markings are essentially self explanatory, and after carefully studying Table 2–1, which lists the functions of the various controls and terminals, the operator should find it possible to master the controls with a minimum of experimentation. Detailed instructions on the operation of the controls to make use of all the features of the instrument are given in subsequent paragraphs.

TABLE 2-1
FRONT-PANEL FACILITIES

NAME	FUNCTION
INTENSITY	Control: varies the trace brightness
FOCUS	Control: adjusts the trace sharpness
Y POSITION	Control: positions the trace vertically
X POSITION	Control: positions the trace horizontally
X D–C BAL	Control: when properly adjusted, prevents horizontal movement of the trace when the (X) AMPLITUDE control is varied; also, for the Type 340, used to position the trace for center-screen expansion
Y D–C BAL	Control: when properly adjusted, prevents vertical movement of the trace when the (Y) AMPLITUDE control is varied
SYNC SELECTOR	Control: selects source of sweep synchronizing signals (EXT, LINE and INT)
SYNC AMPLITUDE	Control: selects polarity and adjusts the amplitude of sweep synchronizing signals

section 2
operation

FIGURE 2-1. FRONT-PANEL FACILITIES

TABLE 2-1
FRONT-PANEL FACILITIES (Continued)

NAME	FUNCTION
Y SELECTOR (Y) AMPLITUDE	Concentric controls: Type 340: outer knob—Y SELECTOR—selects signals, either A-C or D C coupled, from the Y INPUT terminal for application to the vertical amplifier. Front-panel markings indicate approximate voltages for full scale deflections (0.1, 1, 10 and 100) Type 341: outer knob—Y SELECTOR—selects signals, either A-C or D-C coupled, from the Y INPUT terminal or from the COAXial connector (rear-panel) for application to the vertical amplifier. Front-panel markings indicate no-signal attenuation (COAX or 1), or attenuation of applied signals by factors of 10 or 100 Type 340/341: inner knob—(Y) AMPLITUDE—provides continuous amplitude variation of vertical deflection
X SELECTOR (X) AMPLITUDE	Concentric controls: Type 340/341: outer knob—X SELECTOR—same as Y SELECTOR except that X INPUT signals are applied to the horizontal amplifier and internal signals (DRIVEN or RECUR SWEEP) may be selected Type 340/341: inner knob—(X) AMPLITUDE—provides continuous amplitude variation of horizontal deflection
SWEEP RANGE VERNIER	Concentric controls: Outer knob—SWEEP RANGE—Varies sweep frequency in steps. EXT CAP position provides for connection of external capacitance for low-frequency sweep Inner knob—VERNIER—provides continuous variation of sweep frequency within the approximate limits established by the setting of the SWEEP RANGE control
Y INPUT	Binding posts: connections for external signals to the vertical amplifier, either balanced or single ended
X INPUT	Binding posts: connections for external signals to the horizontal amplifier, either balanced or single ended, except when X SELECTOR is set at DRIVEN or RECURrent SWEEP
EXT SYNC	Binding posts: provides for connection of external synchronizing signals to the EXT position of the SYNC SELECTOR switch
TEST SIG	Binding posts: provides line-frequency signal output for external test purposes
POWER ON	Toggle switch: applies primary power to the instrument

REAR-PANEL FACILITIES

(Accessible at Rear of Cabinet or Dust Cover)

X DIR	Plug: provides for direct connections of signals to horizontal deflection plates
EXT CAP	Plug: connection for an external capacitor when X SELECTOR is set to EXT CAP

REAR-PANEL FACILITIES (Continued)

(Accessible at Rear of Cabinet or Dust Cover)

Z AXIS	Plug: provides for connection of external signals to intensity modulate the trace
Y DIR	Plug: provides for direct connection signals to vertical deflection plates
Y INPUT	Type 341 Coaxial connector: connection for external single-ended signals to the vertical amplifier.
X INPUT	Type 341 Coaxial connector: connection for external single-ended signals to the horizontal amplifier

3. Precaution Against Screen Burning

A sharply focused spot of high intensity and small area should not be permitted to remain stationary on the screen for any length of time. Under such conditions, the entire beam energy is concentrated over a small area, thus subjecting the screen material to burning and discoloration. This condition is most likely to exist when using the driven mode of sweep operation, with the INTENSITY turned up, and no signal input. Always keep the INTENSITY low and never allow a spot to remain stationary on the screen.

4. Energizing the Equipment

To place the instrument in operation, plug the power cord into the line outlet, and turn ON the POWER switch. Allow approximately one minute for the instrument to warm up; in the meantime, set the various controls as indicated in Table 2-2.

5. Preliminary Adjustments

Center the spot with X POSITION and Y POSITION controls. If the spot moves as the (Y) AMPLITUDE control is rotated, the Y D-C BAL control should be adjusted in the following manner:

Step 1. Make sure that Y SELECTOR is OFF and set (Y) AMPLITUDE fully CCW

Step 2. Center the spot with Y POSITION control

Step 3. Set (Y) AMPLITUDE control fully CW

TABLE 2-2
PRELIMINARY CONTROL SETTINGS

CONTROL	POSITION
Y POSITION, X POSITION	Center of range
INTENSITY, FOCUS	Center of range
Y SELECTOR	OFF
(Y) AMPLITUDE	Center of range
SYNC SELECTOR	INT
SYNC AMPLITUDE	Fully CCW
X SELECTOR	RECUR SWEEP
(X) AMPLITUDE	Fully CCW
SWEEP RANGE	50–250
VERNIER	Center of range

Step 4. Recenter the spot with Y D-C BAL control

Step 5. Repeat steps 1 through 4 until no vertical displacement of the spot is observed while varying the (Y) AMPLITUDE control throughout its range. Note: If satisfactory balance cannot be achieved, replace V101 (Type 340) or V104 (Type 341). These are preselected tubes and may prove critical in replacement. The Du Mont Instrument Service Department can supply these selected tubes.

Patch the TEST SIG to the Y INPUT terminals. Set Y SELECTOR to 0.1 (Type 340) or 1 (Type 341) and adjust (Y) AMPLITUDE to obtain a vertical deflection of about two inches. Rotate the INTENSITY control clockwise to obtain a trace having normal brightness and set the FOCUS control for best definition. Next, adjust (X) AMPLITUDE to expand the trace. If display tends to move off screen, either to the left or right, adjust X D-C BAL to position the pattern back on screen. Finally, adjust SYNC AMPLITUDE and (SWEEP) VERNIER controls for a stable pattern about three inches wide. Remove patching cord at conclusion of tests.

6. Operating Hints for the Sweep Circuit

a. DRIVEN SWEEP

Refer to the Technical Summary Sheet, Table 1-1, for information on sync sensitivities, and to the Front-panel Facilities, Table 2-1, for information on control functions.

A stable pattern for practically all types of signals can be obtained by using driven sweep; its use is mandatory for viewing random or aperiodic signals or periodic signals of low duty cycle. When operating the instrument in this manner, one sweep occurs for each signal impulse or submultiple thereof. Use of the driven sweep mode of operation, in the majority of applications, is the condition under which optimum performance can be expected of this equipment.

When the oscillograph is set for driven sweep, the spot will be visible only during forward sweep time, provided the INTENSITY control is not set too far clockwise.

Table 2-3 lists the control settings and adjustment procedures for driven sweep operation.

b. CENTER-SCREEN EXPANSION

Signal expansion is symmetrical, linear, and always occurs about the point determined by the setting of the X POSITION control. Proper adjustment of this control is made when the (X) AMPLITUDE control is set *fully CCW*. The X D-C BAL control is employed to *position* the desired portion of the pattern on the screen for expansion.

To expand a given waveform about the screen center, preset the controls as indicated in Table 2-3 and follow the instructions outlined under "Procedure." Note: X SELECTOR may also be set at RECUR SWEEP for signal expansion. Next, position the desired portion of the waveform for expansion to the center of the screen with the X D-C BAL control and expand the entire display with the (X) AMPLITUDE control. This feature eliminates the need to reposition the desired information back on the screen after expansion. In addition, it also permits externally calibrated time measurements by repositioning the expansion point, with the X POSITION control, two inches to the left of center.

c. RECURRENT SWEEP

In some applications it is desirable to have the sweep free-running, whether synchronized or not. To achieve this condition proceed as follows: Set up the controls as indicated in Table 2-3 except that X SELECTOR is set at RECUR SWEEP.

One advantage of this mode of operation, is the ability of the sweep to be synchronized to high-frequency repetitive functions beyond that of driven sweep operation. Another advantage is the display of non-synchronous waveforms.

d. EXTENSION OF LOW-FREQUENCY SWEEPS

Provision is made for connecting external capacitors to the EXT CAP plug (rear panel) to obtain lower speed sweeps than provided for in the instrument. The lowest sweep frequency obtainable without resorting to external capacitors is about two cycles per second. For lower speed sweeps, proceed as follows: Set SWEEP RANGE control at EXT CAP and connect an external capacitor to the EXT CAP Two-pin plug provided at the rear of the instrument. For each microfarad of external capacitance, approximately five seconds of sweep time is secured. Note: A high-leakage-resistance capacitor of the highest possible quality, such as a paper dielectric type, should be employed to preserve sweep linearity. (CAUTION: EXT CAP terminals are approximately 150 volts above ground)

7. Operating Hints for the Vertical Amplifier

a. Y D-C BAL ADJUSTMENT

When this control is properly adjusted, there will be no vertical displacement of the trace with changes in the setting of the (Y) AMPLITUDE

TABLE 2-3
INITIAL CONTROL SETTINGS FOR DRIVEN SWEEP OPERATION

CONTROL	INITIAL SETTING
X SELECTOR	DRIVEN SWEEP
(X) AMPLITUDE	Fully CCW
Y SELECTOR	Set as determined by amplitude of signal source or at 0.1 (Type 340) or 1 (Type 341), AC- or D-C
(Y) AMPLITUDE	Fully CCW
SYNC AMPLITUDE	0
INTENSITY and FOCUS	Approximately 1/3 CW
X POSITION and Y POSITION	Center of range

PROCEDURE

a. Apply the desired signal to Y INPUT

b. Adjust SYNC AMPLITUDE to + or – (to initiate the sweep) and rotate X POSITION to center the vertical trace (line) horizontally

c. Adjust (Y) AMPLITUDE in conjunction with Y SELECTOR to obtain a vertical deflection of about two inches.

d. Gradually adjust X AMPLITUDE to expand the trace. If display tends to move off screen, either to the left or right, adjust X D-C BAL to position the pattern back on screen

e. Rotate the SWEEP RANGE and VERNIER controls to obtain the desired number of cycles on screen. Readjust SYNC AMPLITUDE if necessary

f. Adjust the INTENSITY and FOCUS controls to obtain a sharp trace at a suitable brightness level

g. If there is any multiple triggering of the sweep, the SYNC AMPLITUDE control may be corrected to select the signal level which will best actuate the gate circuit. Thus, any intervening variations of lesser amplitude will not affect the sweep

control. For adjustment procedure, see paragraph entitled "Preliminary Adjustments."

b. SINGLE ENDED Y INPUT

Signals to be observed are connected to the vertical channel through the Y INPUT terminal and ground. For the Type 341 only, signals may also be connected to the COAX terminal (rear panel) for application to the vertical amplifier. The Y SELECTOR permits capacitive or direct coupling of the signal to the compensated attenuator. The terminals for direct connection to the cathode-ray tube are accessible at the rear of the cabinet or dust cover. (See paragraph 9 for details.)

c. USE OF BALANCED INPUT (See Figure 2-2)

For balanced input, remove the link from the normally grounded Y INPUT terminal. The Y SELECTOR must be set to the 0.1 D-C position for the Type 340; for the 341, the 1 D-C position. The following explanation of the balanced-input feature may help the operator to determine when this type of operation may be useful or desirable.

If there is an in-phase signal applied to both inputs (known as a "common-mode" signal) superimposed on the balanced-input signal, the maximum input signal (d-c plus peak signal a-c) will be accordingly reduced.

One of the features of the balanced-input circuit is the differential action of the amplifier. This circuit makes it possible to reject to a considerable degree any common-mode signal, while at the same time passing and amplifying the balanced-input signal. Thus, if there is any pickup of noise on test leads or in the equipment under test, such noise will be reduced materially on passing through the balanced-input amplifier circuit.

The waveforms shown in Figure 2 2 illustrate the advantage of the balanced-input connection over the single-ended in such cases. A push-pull test signal on which a common "nuisance" signal is superimposed, is applied to the balance-input connection of the instrument (Figure 2-2a). Then, this same signal, passed through a network to convert it to unbalanced output, is applied to the unbalanced-input connection of the instrument (Figure 2-2b). Note how much greater the amplitude of the common-mode signal appears with the unbalanced-input connection.

8. Operating Hints for the Horizontal Amplifier

a. GENERAL

The Types 340 and 341 both contain identical horizontal and vertical amplifiers. This results in very small relative phase shift between X and Y signals, provided that the (X) and (Y) AMPLITUDE controls are set comparably. See Table 1-1 for additional information. For those applications where it is desirable to apply an external signal through the horizontal amplifier, the amplifier should first be adjusted for d-c balance as outlined in the next paragraph.

b. X D-C BAL ADJUSTMENT

When this control is properly adjusted, there will be no horizontal displacement of the spot with changes in the setting of the (X) AMPLITUDE control. To adjust, proceed as follows:

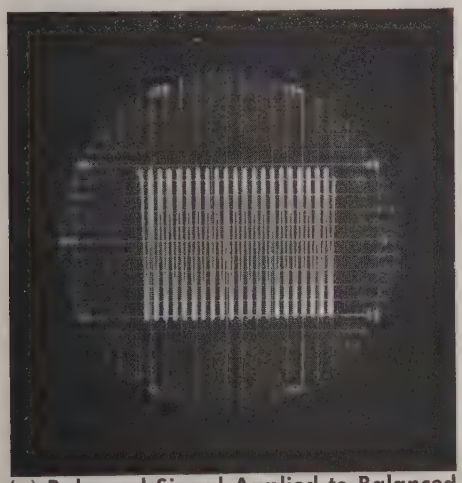
Step 1. Set X SELECTOR at OFF and (X) AMPLITUDE fully CCW

Step 2. Center the spot with X POSITION control

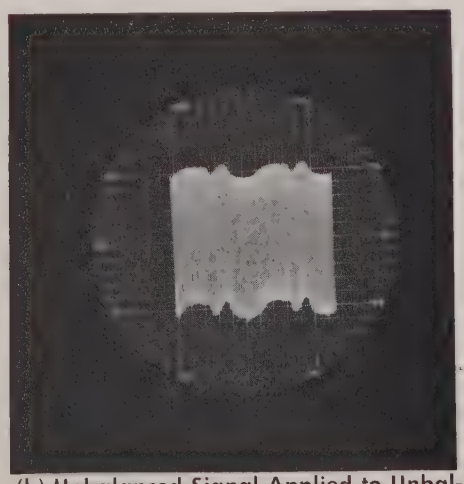
Step 3. Set (X) AMPLITUDE control fully CW

Step 4. Recenter the spot with X D C BAL control

Step 5. Repeat steps 1 through 4 until no horizontal displacement of the spot is observed while varying the (X) AMPLITUDE control throughout its range. Note: If satisfactory balance cannot be achieved replace V301 (Type 340) or V304 (Type 341). These are preselected tubes and may prove critical in replacement. The Du Mont Instrument Service Department can supply these selected tubes.



(a) Balanced Signal Applied to Balanced Y Input



(b) Unbalanced Signal Applied to Unbalanced Y Input (Note: Sweep rate has been decreased)

Figure 2-2. EFFECTIVENESS OF BALANCED INPUT IN ELIMINATING "COMMON-MODE" SIGNALS.

c. X INPUT

When using the horizontal amplifier for external signals (X INPUT), set X SELECTOR to A-C or D-C. When this switch is set to either of these positions, the internal sweep is disconnected and the X INPUT terminals are connected to the horizontal amplifier. However, the sweep gate circuit is not disabled unless the SYNC AMPLITUDE is set at "0." Application of singled-ended or balanced signals to X INPUT is identical to that described for the vertical amplifier.

d. X AMPLIFIER GATED BEAM OPERATION

If gated-beam operation is desired when using both the vertical and horizontal amplifiers, it can be obtained by triggering the sweep (which is placed in the driven mode when the X SELECTOR is set for external signals) with EXT, INT, or LINE signals just as in normal operation. Thus, it is possible while viewing external signals, to superimpose the brightening gate on the trace. The duration of the brightening gate may be adjusted by the SWEEP RANGE and VERNIER controls. If this feature is not desired, set SYNC AMPLITUDE at "0."

9. Direct Connection to Deflection Plates

a. GENERAL

When applying signals to deflection plates, the highest-frequency signal that can be observed is not limited by the response of the built-in amplifiers but is dependent upon input capacitance to the deflection plate terminals and/or transit time of the electrons between the deflection plates. Provided the impedance of the signal source is kept low, transit time is the only consideration. It should be remembered, however, that no amplification or attenuation is provided on "direct input" and that approximately 24 D-C or P-P volts are required to produce an inch of deflection.

b. MAKING PROPER CONNECTIONS

Caution

Before making connections, shut off power.

Direct connection to the deflection plates can be made by removing the appropriate twin lead two-pin plug at the rear of the cabinet, and by noting the following information:

(1) Deflection plate return resistors must be provided. Singled-ended input, 5 megohms (maximum) either plate to ground; balanced input, 10 megohms (maximum) center-tapped to ground.

(2) The average d-c potential of approximately 250 volts above ground must be preserved on both pairs of deflection plates.

(3) This average d-c level should be made adjustable to provide an astigmatism control for optimum focus adjustment.

(4) To avoid any possibility of cross-coupling effects, it is suggested that, when connecting a signal direct to deflection plates, the corresponding channel (X SELECTOR and/or Y SELECTOR) controls be switched to OFF.

(5) A loss of positioning will occur.

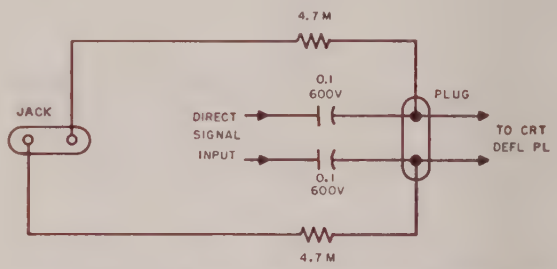


FIGURE 2-3. CIRCUIT FOR DERIVING POSITIONING VOLTAGE FOR SIGNALS COUPLED DIRECT TO DEFLECTION PLATES

c. DERIVING POSITIONING VOLTAGES (See Figure 2-3)

A suggested method of deriving positioning voltages from the horizontal and/or vertical amplifiers is as follows:

Step 1. Disconnect the appropriate CRT deflection-plate from its jack (rear of cabinet).

Step. 2. Bridge the plug and mating jack with a series resistor (4.7 megohms) in each leg. Note: The idle EXT CAP or Z AXIS plug (rear of cabinet) may be employed to facilitate connection of the series bridging resistors.

Step 3. Connect the signal through blocking capacitors of at least 600 volts d-c rating.

Employment of these steps preserves the deflection-plate voltages and obviates the need for return resistors.

10. Intensity Modulation

Positive signals applied to Z input will decrease the beam intensity. To make this connection, shut off the power and apply the signal to the Z AXIS plug at the rear of the instrument. Note: Z input presents an impedance of 30,000 ohms and 30 μμf to the signal source.

11. Making Rise Time Measurements

Application of signals from an external time calibrator will facilitate pulse rise-time measurements. When making such measurements, the one factor which must be borne in mind for most accurate quantitative results is the pulse response characteristic of the vertical amplifier. This characteristic is related to the observed pulse rise time and the actual pulse rise time in the following manner:

$$t_{ro} = \sqrt{t_{ra}^2 + t_{rp}^2}$$

Where t_{ro} is the observed rise time; t_{ra} is the minimum rise time of the amplifier; t_{rp} is the signal rise time. Once the amplifier rise time is known, the rise time of any pulse may be calculated.

Since deflection-plate misalignment is virtually eliminated through the use of tight-tolerance cathode-ray tubes which allow a maximum of 1° of misalignment, no correction for this factor should be necessary.

12. Photographic Recording

As an aid in amplitude and time calibration, both for visual measurements and for permanent records by photographic recording, an illuminated scale over the face of the cathode-ray tube is a desirable adjunct to an oscillograph. The Du Mont Type 2563-Illuminated Scale Kit provides this facility and is available as an accessory.

section 3
theory of operation

1. General

In following the theory discussion, it is suggested that the over-all block diagram in Section I and the over all circuit schematics (just inside the back cover of the manual) be referred to in addition to the simplified functional block diagrams in this section.

2. Cathode-ray Tube and Beam Gate Circuit (See Figure 3-1)

a. MONO-ACCELERATOR TUBE

The Types 340 and 341 features the new mono-accelerator, high-resolution, tight-tolerance cathode-ray tube (5AQP–). Owing to the unique electronic gun and accelerating system, geometric distortion is greatly reduced and may be virtually ignored in most exacting applications. Excellent spot size, focus and pattern brilliance are readily apparent. This tube is operated at a total accelerating potential of 1500 volts.

b. FOCUS

Focusing of the beam for maximum "sharpness" of trace is accomplished by adjusting the FOCUS control (R411). The setting of this control establishes the relative potential difference between the focus anode and cathode. The vertical deflection plates (D3 and D4) and the horizontal deflection plates (D1 and D2) operate at an average d-c potential of approximately 250 volts above ground. To avoid beam distortion, the second anode must operate at approximately the same d-c potential. The second anode voltage for the Type 340 is derived from the junction of R128 and R129. The voltage at this junction is controlled by the ASTIG ADJ (R118) located in the cathode circuit of V102.

The second anode voltage for the Type 341 is obtained from the arm of the ASTIG ADJ potentiometer (R416).

c. INTENSITY MODULATION

For the purpose of intensity modulating the beam, positive (blanking) or negative (brightening) signals may be applied to the Z AXIS two-pin plug through a coupling capacitor (C402) to the cathode of the cathode-ray tube.

d. R-F POWER SUPPLY (See over-all schematic)

Operating potentials for the proper intensity and focusing of the CRT beam are derived from the r-f power supply. This circuit consists of an r-f power oscillator (V501), an r-f type transformer having a high turns ratio and a powdered iron core (T501) and a –HV diode rectifier (V502). The –1200 V rectified output of the half-wave rectifier (V502) is filtered by a pi-type R-C network (C502, R501 and C501). The high-voltage output is controlled by the HV ADJ (R503) which varies the screen voltage of the r-f power oscillator (V501).

The advantages of r-f supply system of generating CRT accelerating potentials, compared to that of the conventional "brute force," low-frequency systems are:

(1) Elimination of high-voltage, high-capacitance filters which are expensive and bulky.

(2) Sharp reduction in shock hazard because of the smaller capacitors used in the filter system.

e. BEAM GATE AND INTENSITY CIRCUITS (See over-all schematic)

(1) GENERAL DESCRIPTION

The very low sweep frequencies involved in the Types 340 and 341 make it necessary for the CRT to be turned on for the duration of the long sweep interval and then turned off automatically. Since the grid of the CRT is at a high negative voltage and the source of the brightening gate is a potential of approximately +150 volts, some means of transferring this gate, from a low d-c level to a high d-c level, is required. Ordinary capacitive coupling would not be feasible since the very long time-constants involved would indicate the use of a prohibitively large capacitor.

To circumvent this problem, a conventional bistable multivibrator (V402—beam gate generator) is incorporated. The mean d-c level of this stage is equal to the average level of the CRT accelerating potential. Thus, only short pulses are needed to trigger V402 on or off, enabling the use of a much smaller coupling capacitor.

(2) DETAILED DESCRIPTION

Under stable conditions, the constants of the beam gate circuit are such that V402-A is at "cut-off" and V402-B fully conducting. When the sweep starts, the negative leading edge of the gate coupled from the cathode of V203-B is applied to the grid (pin 7) of V402-B, turning off this stage and turning on V402-A. Thus, the grid of the CRT is held above cutoff for the duration of the forward sweep time. V402 is restored to its original condition by the positive-going trailing edge of the sweep gate.

The intensity of the beam is adjusted by varying the INTENSITY control (R413). This control varies the cathode potential more or less positive with respect to the grid, which is held at a mean fixed negative potential.

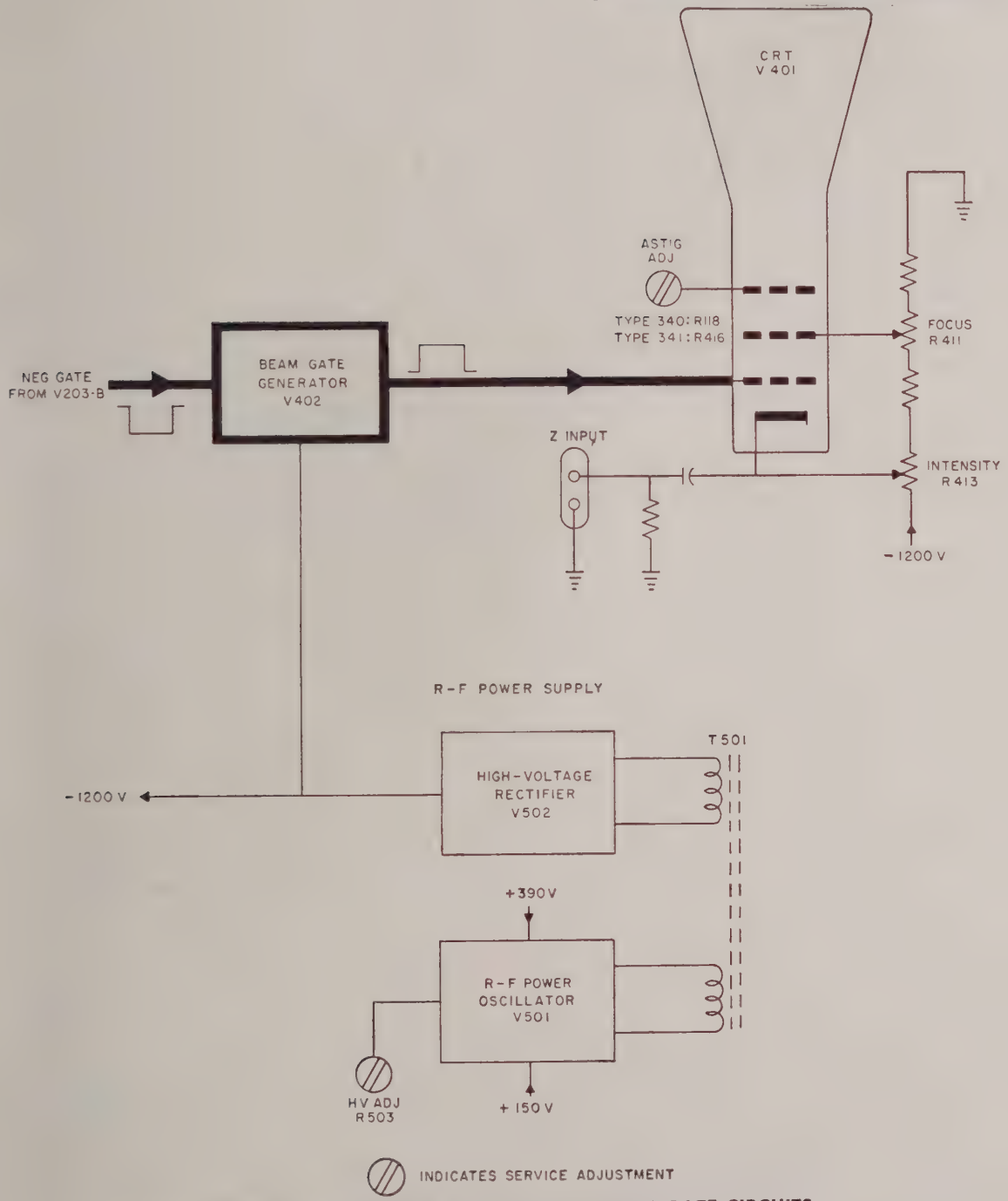


FIGURE 3-1. CATHODE-RAY TUBE AND BEAM GATE CIRCUITS, FUNCTIONAL BLOCK DIAGRAM. (TYPE 340/341)

3. Vertical Amplifier Circuitry for the Type 340 (See Figure 3-2)

a. GENERAL

To facilitate circuit analysis, the vertical-deflection circuit may be considered as consisting of:

(1) A frequency-compensated attenuator

(2) A high-gain, medium-band direct-coupled amplifier for increasing the amplitude of low level signals for suitable display on the cathode-ray tube screen.

b. Y INPUT SELECTOR SWITCH AND INPUT ATTENUATORS (See over-all schematic)

The input decade attenuators are R-C compensated to maintain frequency and phase response and to present an impedance of 2.0 megohms in shunt with 50 μμf (maximum) to the circuit under test, regardless of the attenuation selected. The Y INPUT SELECTOR switch (S101) selects the desired attenuation of the input signal in steps of approximately 0.1 V, 1.0 V, 10 V, and 100 V full scale for both A-C and D-C inputs. The OFF position of this switch removes the input signal from the attenuator and grounds the grid (pin 2), of the input d-c amplifier (V101-A.)

Provision is made for applying a balanced signal to Y INPUT when the Y INPUT SELECTOR switch is set to 0.1 (D-C) position. For details on use of this feature, refer to the instructions contained in Section 2, paragraph 7c.

c. D-C AMPLIFIER OPERATION

The vertical deflection d-c amplifiers comprise V101 through V103, inclusive. The d-c balanced circuit arrangement provides good deflection amplifier stability. The input d-c amplifier (V101) (which on balanced inputs acts effectively as a differential amplifier) precedes the continuously variable (Y) AMPLITUDE control (R114). R115, in series with this control, prevents the operator from cutting the gain all the way to zero. Thus, any signal large enough to saturate the input stage will cause greater than full-screen deflection and can be observed only after the attenuator control (Y SELECTOR) is set at a higher voltage position or if the amplitude of the applied signal is reduced. This feature prevents internally generated distortion. The nor-

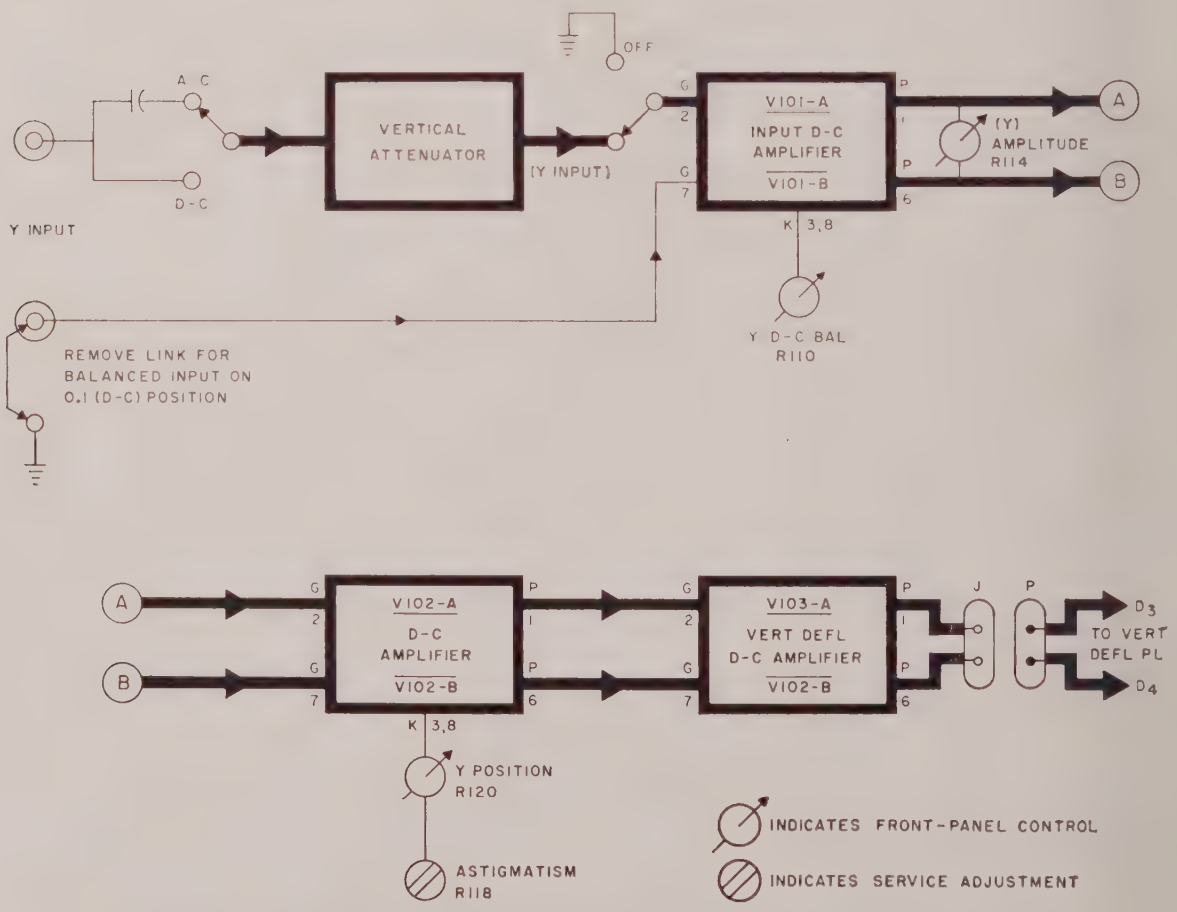


FIGURE 3-2. VERTICAL AMPLIFIER, FUNCTIONAL BLOCK DIAGRAM (TYPE 340)

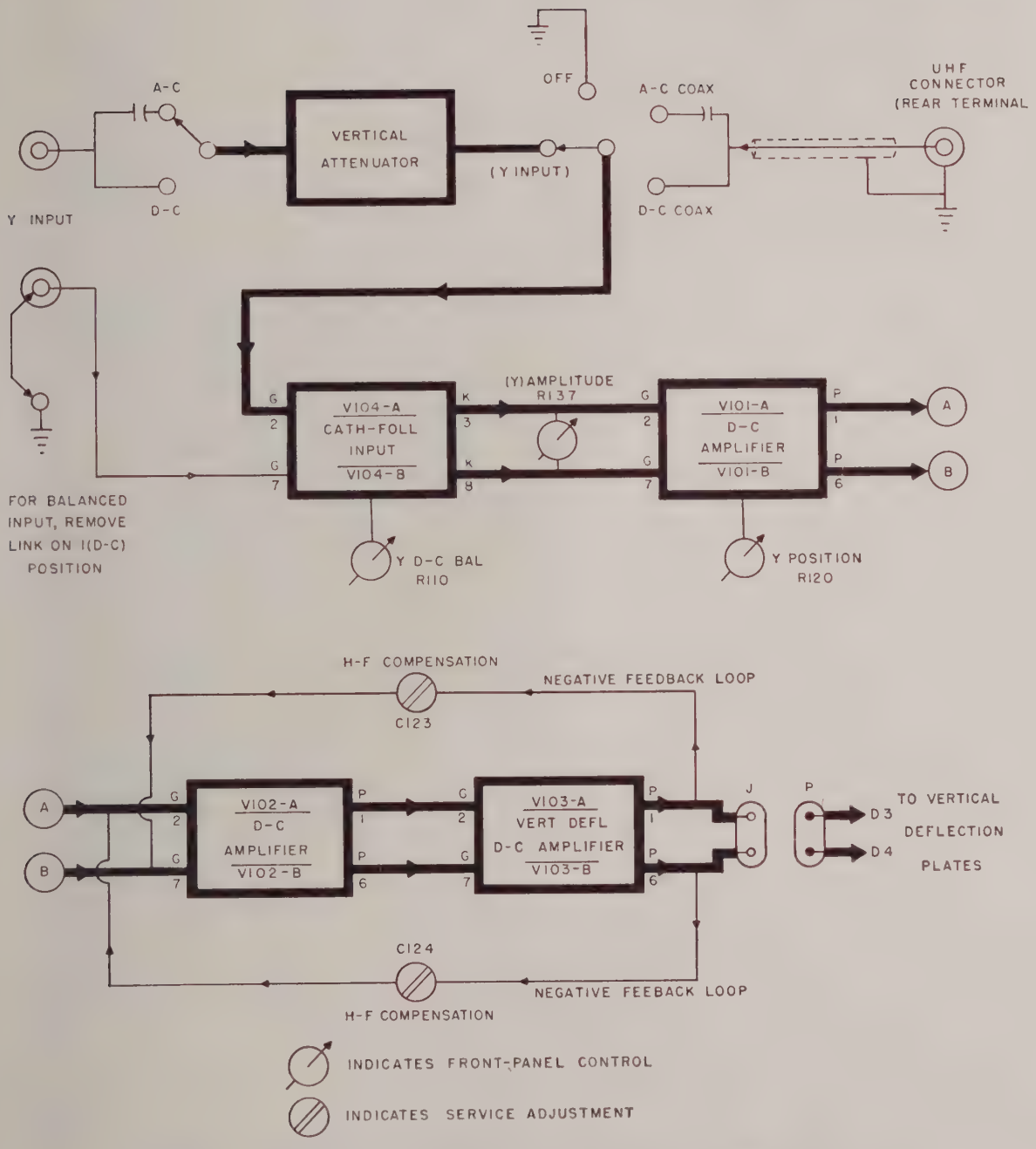


FIGURE 3-3. VERTICAL AMPLIFIER FUNCTIONAL BLOCK DIAGRAM (TYPE 341)

mally grounded grid (pin 7) of V101-B is brought out to the front-panel jack (J102) so that balanced input operation may be obtained simply by removing the ground link between J102 and J103 (front-panel terminals). The resistors (R107 and R108) in series with the grids of V101 serve to protect the input circuit from damage due to excessive input voltage.

A variable capacitor (C119) is provided which is adjusted to minimize capacitively coupled heater voltage harmonics. R603 minimizes the fundamental power line hum component.

The Y D-C BALance adjustment (R110) equalizes the voltage at the ends of the (Y) AMPLITUDE control. When this adjustment is properly set, there will be no shifting (up and down) of the trace on moving the (Y) AMPLITUDE control from minimum to maximum with no input signal to the amplifier.

The printed wiring capacitors (shown without reference symbols on the over-all schematic) are employed to neutralize the input Miller-capacity effect.

The positioning system provided is such that even with a vertical deflection equivalent to three times full-screen diameter, any full screen portion of this vertical deflection may be centered on the screen by the Y POSITION control (R120).

d. DIRECT INPUT

Provision is made for direct input to the vertical deflection plates. Refer to paragraph 9 in Section 2, Operation, for the use of this feature.

4. Vertical Amplifier Circuitry for the 341 (See Figure 3-3)

Since the Types 340 and 341 amplifiers circuits are similar, the discussion will be limited to the differences between them. These differences are:

(1) Gain has been traded for bandwidth in the Type 341 such that the vertical amplifier has a sensitivity of 400 millivolts full scale as compared to 100 millivolts full scale required by the Type 340.

(2) An extra d-c amplifier stage has been added to increase the bandwidth from 30% down at 100 kc (Type 340) to 30% down at 600 kc for the Type 341.

(3) High-frequency compensation is provided by two frequency-compensated degenerative R-C networks connected from the plates of V103-A and V103-B, to the grids of the preceding stage (V102-B and V102-A).

(4) UHF connectors are available at the rear of the Type 341 for the application of video or other signals on coaxial lines. The UHF connectors are switched into the amplifier when Y SELECTOR is set at COAX. Signals applied to these connectors do not pass through the attenuators when this method of connection is used.

(5) Undistorted deflection for the vertical amplifier is limited to four inches.

(6) A phase shift service adjustment (C118) is provided to minimize the relative phase shift between the horizontal and vertical amplifiers. Proper adjustment is made when the amplifier sensitivities are equalized.

5. Sync Circuit for the Types 340 and 341 (See Figure 3-4)

The SYNC SELECTOR switch (S201) provides selection of the synchronizing signal; INT (signal obtained from the plate of V103-B in the vertical channel); LINE frequency; or EXTernal (signal obtained from an external source).

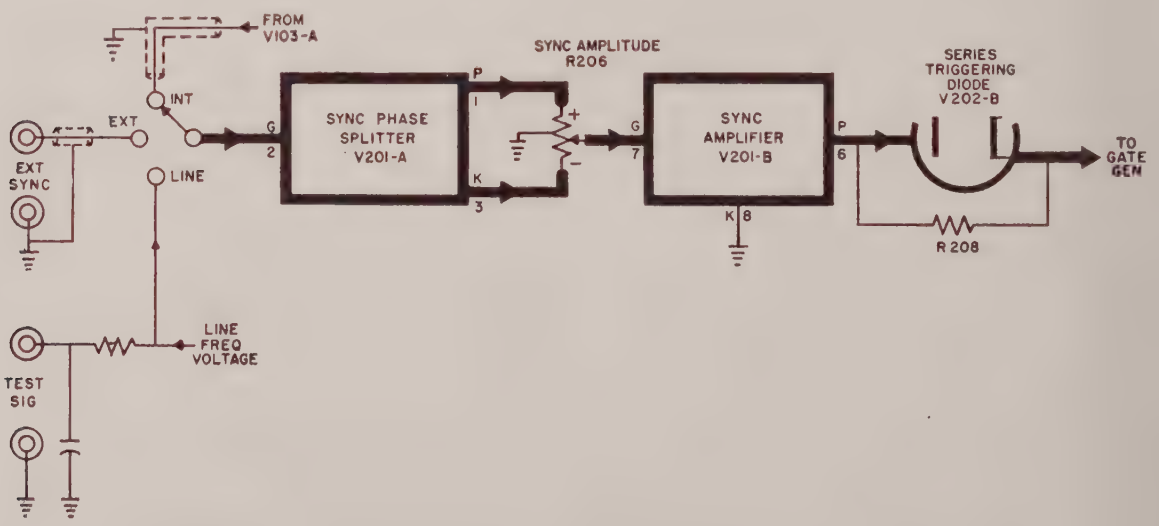


FIGURE 3-4. SYNC CIRCUIT FUNCTIONAL BLOCK DIAGRAM (TYPE 340/341)

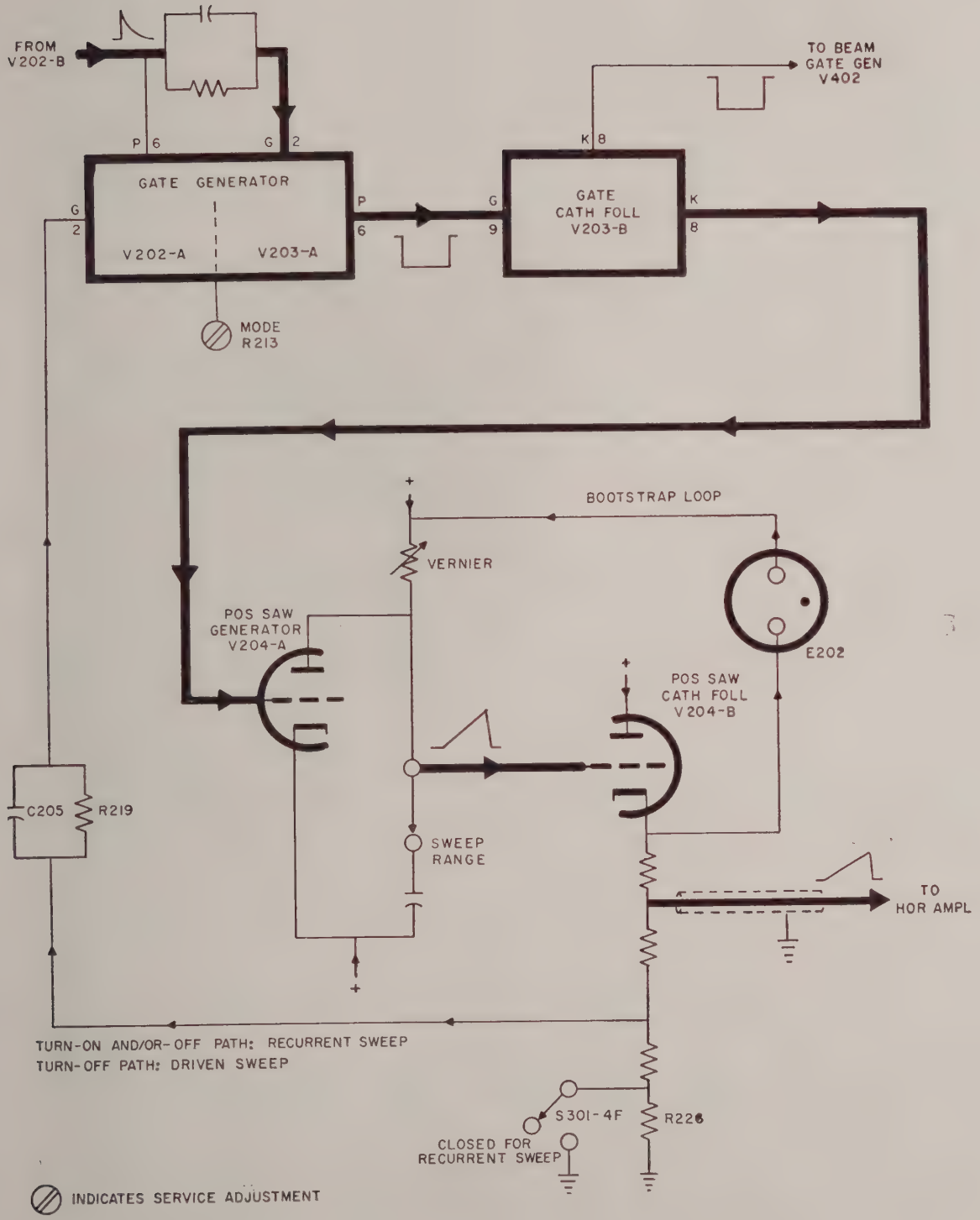


FIGURE 3-5. GATE AND SWEEP CIRCUITS, FUNCTIONAL BLOCK DIAGRAM (TYPE 340/341)

section 3
theory of operation

V201-B functions as a sync phase splitter. The SYNC AMPLITUDE control (R206) enables the operator to select the desired amplitude and polarity of the sync voltage. Following this control is the series triggering diode which is shunted by a resistor (R208) to facilitate recurrent sweep synchronization. This diode serves as a sync lockout stage during the forward sweep time as follows: When the gate generator is initiated (V202-A and V203-A), the plate of V202-A rises essentially to its plate-supply voltage. Since the cathode of V202-B is connected at this point, V202-B becomes automatically nonconductive during the forward sweep time, thereby preventing the passage of unwanted sync signals.

6. Gate and Sweep Circuits for the Types 340 and 341 (See Figure 3-5)

a. DRIVEN SWEEP

(1) GATE CIRCUIT

V202-A and V203 A are connected as a bistable gate generator. The MODE service adjustment (R213) is set such that, initially, V202-A is fully conducting and V203-A is at cutoff. V203-A is initiated by a positive going signal applied to its grid, resulting in a sudden transition of V203-A from cutoff to full conduction. Conversely, the other half of the gate generator (V202-A) is turned off. The negative gate developed at the plate of V203-A is coupled to a gate cathode-follower stage (V203-B).

(2) POSITIVE SAW GENERATOR

The negative gate output from the cathode of V203-B is coupled to the grid of the positive saw generator (V204-A), which is normally conducting and maintaining the sweep charging capacitor in a discharged state. This gate turns off V204-A and allows the voltage at its plate to rise at a rate determined by the setting of the SWEEP

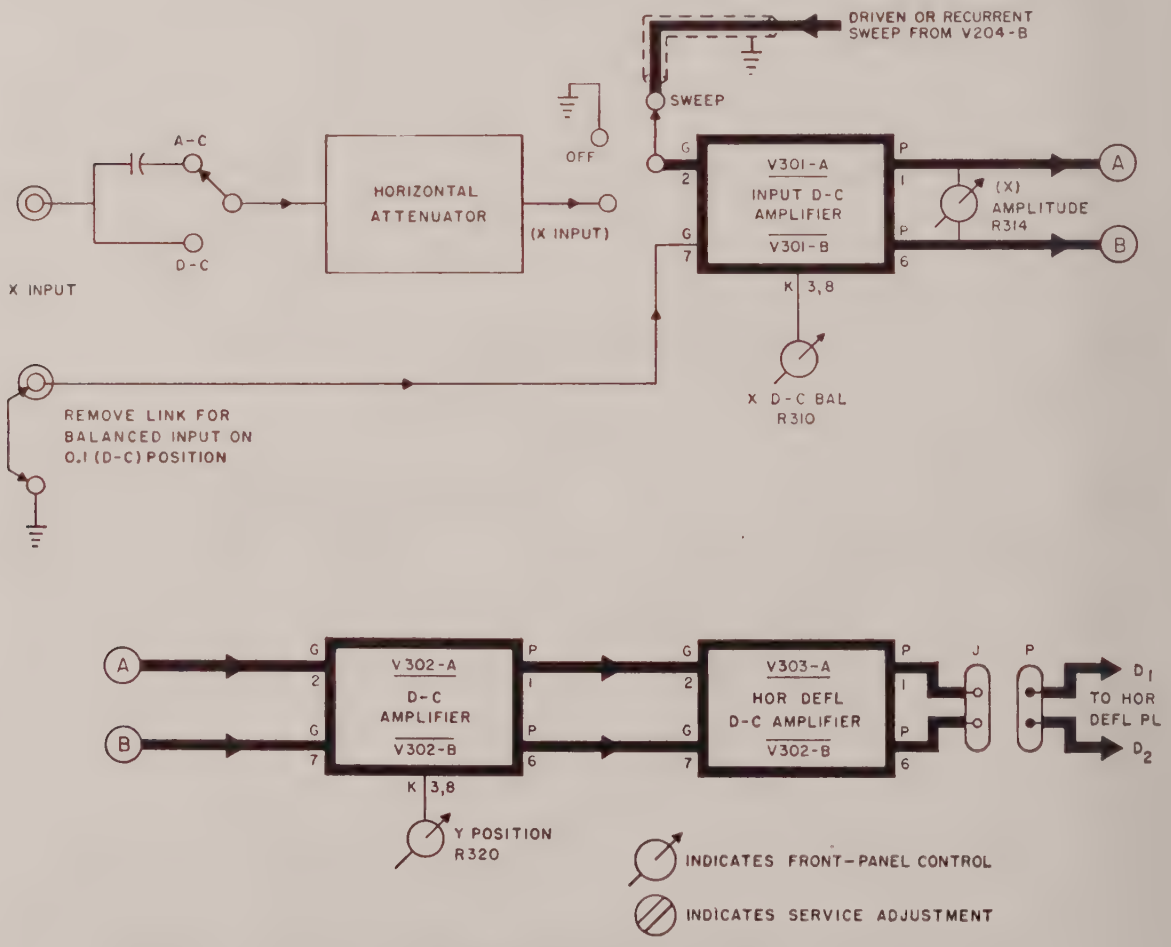


FIGURE 3-6. HORIZONTAL AMPLIFIER, FUNCTIONAL BLOCK DIAGRAM (TYPE 340)

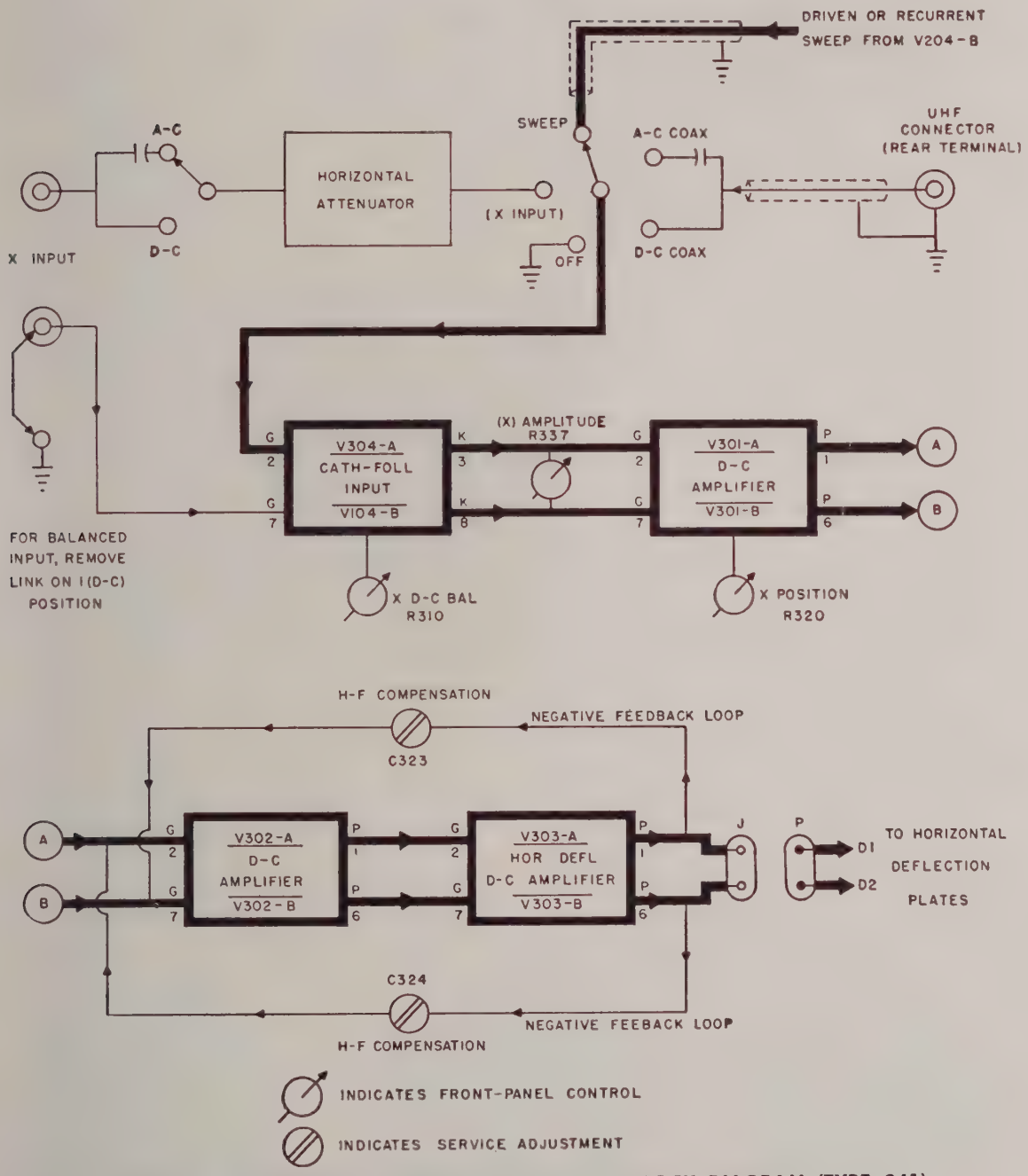


FIGURE 3-7. HORIZONTAL AMPLIFIER FUNCTIONAL BLOCK DIAGRAM (TYPE 341)

RANGE and VERNIER controls. The resultant sawtooth voltage across the charging capacitor is coupled to the positive saw cathode follower (V204-B) and thence to the horizontal amplifier by means of the X SELECTOR switch.

The voltage at the cathode of V204-B is fed back to the grid of the nonconducting gate tube (V202-A) via an R-C coupling network (R219 and C205). This restores the gate generator to its initial operating condition (when the positive saw reaches a pre-determined level) thus terminating the sweep. The beam will sweep the

screen again only upon application of another positive-going signal to the grid of V203-A.

A high degree of linearity is achieved by causing the d-c voltage of the charging source to rise at saw rate through use of a gas tube (E202) coupled to the top of the (SWEEP) VERNIER charging resistor. This essentially provides a constant-current charging source for the sweep capacitor.

b. RECURRENT SWEEP

When the X SELECTOR switch is set at RECUR SWEEP, the top of R226 in the saw-divider network is returned to ground. This action establishes a new d-c level of the feedback path to V202-A such that the saw-return trace is able to initiate this stage. Under these conditions, the gate generator (V202-A and V203-A) will essentially be free running. Subsequent development of the positive saw is similar to that described for driven sweep.

RECUR SWEEP synchronization is accomplished near the end of the forward-sweep trace; for DRIVEN SWEEP, it is achieved at the start of the forward sweep. Consequently, a phase shift of 180° will be noted when switching from DRIVEN to RECUR SWEEP or vice versa.

7. Horizontal Amplifier Circuitry for the Type 340 (See Figure 3-6)

Since identical vertical and horizontal amplifiers are employed in the Type 340, the previously discussed theory for the vertical amplifier is equally applicable, except for the X SELECTOR switch (S301).

By means of the X SELECTOR switch, provision is made for the selection of internal or external signals for horizontal deflection. The internal signal is obtained from the driven or recurrent sweep circuits described earlier. External signals may be applied to the X INPUT terminals.

The sensitivity of the horizontal channel is 128 millivolts full scale while that of the vertical channel is 100 millivolts full scale. This difference in sensitivity results from the different deflection factors of the horizontal and vertical deflection plates of the cathode-ray tube. The amplifiers themselves are identical.

When the X SELECTOR switch is set for external signals, the sweep circuit is not disabled unless the SYNC AMPLITUDE control is set at "0." Thus, it is possible to trigger the sweep, while viewing external signals, to superimpose the brightening gate on the trace. For use of this feature, see paragraph 8d, in Section 2, Operation.

8. Horizontal Amplifier Circuitry for the Type 341 (See Figure 3-7)

The Type 341 also employs identical vertical and horizontal amplifiers, hence, reference to the vertical circuitry for the 341 is equally valid. In addition, circuit description of the X SELECTOR switch (See paragraph 7 of this section) is also applicable. See Table 1-1 for amplifier sensitivity.

9. POWER SUPPLY (See Over-all schematic)

A self-regulating power transformer (T601) employing a magnetic shunt and a 60-cycle resonant secondary winding is used to minimize the effect of line-voltage variation. Once resonance is attained, it is used as the basis of maintaining the output voltage of the transformer constant.

V601 is connected in a conventional full-wave rectifier circuit. The rectified output is filtered by a capacitor-input type filter (C601-C, L601 and C601-B).

section 4
maintenance

Warning

POTENTIALS AS HIGH AS 1500 VOLTS EXIST IN THIS INSTRUMENT. OBSERVE THE FOLLOWING PRECAUTIONS WHEN NECESSARY TO ENERGIZE THE EQUIPMENT WITH THE CABINET REMOVED.

(1) Never work alone.
(2) Make sure the chassis is properly grounded.
(3) Disconnect power before changing any tubes.
(4) Before touching any component, short the terminals to remove any possible charge that may remain after removing the power.

1. General

The first step in correcting any trouble or failure that may occur is to isolate the section of the circuit causing the trouble. Such isolation can be accomplished by considering the circuit as composed of the basic sections shown in the over-all block diagram, Figure 1-2.

The next step after isolating the trouble to a particular section is to determine the specific tube circuit involved. A replacement tube should be tried before attempting any other test. *Indiscriminate tube changing must be avoided. If after tube replacement, the trouble persists, replace the original tube in its socket.* NOTE: Replacement of certain tubes will require resetting on one or more service adjustments. Consult Table 4-4 for special instructions. If trouble persists, voltage and resistance measurements should be made.

2. Maintenance Reference Data

a. OVER-ALL SCHEMATICS

Over-all schematics of the circuits will be found at the back of this section and should be consulted while trouble shooting. Lists of the component electrical parts, including descriptions, are also provided.

b. TROUBLE SHOOTING CHART

As an aid in servicing, Trouble Shooting Chart, Table 4-1, indicates symptoms, probable causes of trouble and curative measures.

c. VOLTAGE AND RESISTANCE MEASUREMENTS

Tables 4-2 and 4-3 lists voltages and resistances from tube pins to ground, except as otherwise noted, for the Types 340 and 341 respectively. Voltage measurements shown were taken using a test meter having an internal resistance of 20K ohms/volt except as otherwise noted. Good judgment is often required to determine if a particular deviation from the value shown is indicative of trouble.

d. TUBE LOCATIONS

Tubes may be located by reference to Figures 4-2 through 4-5, 4-7, 4-9, and 4-10.

3. Gaining Access to the Chassis

To remove the instrument from its cabinet, remove the two screws at the back of the cabinet

(A) Correct Waveform (B) Overcompensated (C) Undercompensated

FIGURE 4-1. WAVEFORMS ENCOUNTERED IN ADJUSTING ATTENUATOR COMPENSATION CAPACITORS

and slide the instrument forward, taking care that the line cord is free to slide through the hole provided. For the -R models, in addition to the rear screws, remove the four outermost front-panel screws located at the top and bottom center, and left and right center. Slide the instrument forward while observing the previously mentioned precaution.

4. Service Adjustments

a. GENERAL

Service adjustments may be identified by reference to the call-out illustrations, Figures 4-2 through 4-5, 4-7 and 4-8. Do not touch any service adjustments unless tests clearly indicate the need to do so. Such adjustments should not be attempted without complete understanding of the proper procedure.

Caution

To avoid screen burns, keep intensity low.

b. TEST EQUIPMENT REQUIRED

Description	*Range or Characteristics*
Volt-ohmmeter	20K ohms/volt Test Meter or Electronic Voltmeter
Square-wave Generator	1KC to 100KC

PRECAUTION

DO NOT SET ANY SERVICE ADJUSTMENT WITHOUT FOLLOWING SPECIFIC INSTRUCTIONS AND SEQUENCE GIVEN BELOW. SOME ADJUSTMENTS ARE INTERDEPENDENT.

c. POWER SUPPLY CIRCUIT

(1) HV ADJ for Type 340 (R503—see Figure 4-3)

(2) HV ADJ for Type 341 (R503—see Figure 4-7)

(a) TEST PROCEDURE FOR (1) AND (2).—Check that the high voltage measures –1200 volts (nominal). If not, adjust to –1200 volts by means of R503.

d. CATHODE-RAY TUBE CIRCUIT

(1)ASTIG ADJ for Type 340 (R118—see Figure 4-3)

(2) ASTIG ADJ for Type 341 (R416—see Figure 4-7)

(a) TEST PROCEDURE FOR (1) AND (2).—Check by patching the TEST SIG to Y INPUT. Adjust the appropriate front-panel controls to obtain several cycles on the screen. Adjust the FOCUS control for the sharpest trace, which should now be of uniform width throughout its length. If not, set ASTIG ADJ to obtain this condition. It will probably be necessary to readjust the FOCUS control simultaneously with the ASTIG ADJ to maintain best focus. Once properly adjusted, the ASTIG ADJ should require no further attention under normal conditions.

e. SERVICE ADJUSTMENTS FOR THE VERTICAL AMPLIFIER

(1) HUM BAL for Type 340 (R603—see Figure 4-3)

(2) HUM BAL for Type 341 (R603—see Figure 4-7)

(a) TEST PROCEDURE FOR (1) AND (2) .—Check by setting (Y) AMPLITUDE fully CW and Y SELECTOR fully CCW. Shield the Y INPUT terminals and adjust the appropriate front-panel controls for a trace. The power-line frequency ripple should not exceed 0.05 inch. If it does, adjust the HUM BAL potentiometer to give minimum residual ripple.

(3) Y SELECTOR Compensation Capacitors for Type 340 (C105 through C107—see Figure 4-4)

(4) Y SELECTOR Compensation Capacitors for Type 341 (C105 and C106—see Figure 4-7)

(b) TEST PROCEDURE FOR (3) AND (4) .—These capacitors may be checked by applying a 1 kc square wave signal to Y INPUT and adjusting the appropriate trimmer if necessary to pass the square wave with minimum distortion. Figure 4-1, "A" represents proper adjustment while "B" and "C" represent conditions of over and under-compensation, respectively.

(5) High-frequency Compensation for Type 341 (C123 and C124—see Figure 4-7)—Check by applying a 100 kc square wave signal to Y INPUT and note whether the amplifier passes this

signal with minimum distortion. If not, adjust C123 and C124 to obtain a flat-top square wave.

f. SERVICE ADJUSTMENTS FOR THE HORIZONTAL AMPLIFIER

(1) X SELECTOR Compensation Capacitors for Type 340 (C305 thru C307—see Figure 4-5)

(2) HUM BAL and Hum Harmonic Trimmer for Type 340 (R603 and C319—see Figure 4-2)

(3) X SELECTOR Compensation Capacitors for Type 341 (C305 and C306—see Figure 4-8)

(4) High-frequency Compensation for Type 341 (C323 and C324—see Figure 4-8)

(a) TEST PROCEDURE FOR (1), (2), (3) AND (4).—The checking and adjustment procedure for the horizontal amplifier is identical to that described for the vertical amplifier. Hence, refer to the appropriate paragraph under 4e for the proper checking procedure.

g. PHASE SHIFT ADJUSTMENT (TYPE 341)

(1) Phase Shift Trimmer (C118—see Figure 4-7).—Before checking, make sure that the vertical and horizontal amplifier h-f compensation trimmers are checked out.

To obtain an accurate pattern from which phase difference can be determined between the vertical and horizontal amplifiers, proceed as follows:

Step 1. Apply a 100 kc square wave signal to Y INPUT and set X SELECTOR at OFF.

Step 2. Adjust the Y SELECTOR and AMPLITUDE controls for three inches of vertical deflection; be extremely careful not to disturb the (Y) AMPLITUDE control setting for the remainder of the test.

Step 3. Center the trace with Y POSITION control.

Step 4. Set Y SELECTOR at OFF, SYNC AMPLITUDE at "0," and apply the same 100 kc square wave signal to X INPUT. (Do not remove signal from Y INPUT.)

Step 5. Adjust the X SELECTOR and AMPLITUDE controls to give a horizontal deflection equal to that to which the vertical amplifier is adjusted (three inches); be extremely careful not to disturb the (X) AMPLITUDE control setting throughout the remainder of the test.

Step 6. Center the trace with X POSITION control.

Step 7. Set Y SELECTOR to correspond with X SELECTOR setting.

Step 8. With the vertical and horizontal amplifiers gains equalized, the resulting line should be slanted 45° (towards the right) with the bright spots at either end. If not, adjust C118 to obtain this condition.

h. SWEEP CIRCUIT

(1) MODE for Type 340 (R213—see Figure 4-2)

(2) MODE for Type 341 (R213—see Figure 4-8)

(a) TEST PROCEDURE FOR (1) AND (2).—Improper adjustment of R213 will show up either as operation of the sweep in the DRIVEN mode with the SYNC AMPLITUDE control at "0," or as failure of the sweep to operate in the RECURrent mode.

To adjust, set X SELECTOR at DRIVEN SWEEP and SYNC AMPLITUDE at "0." Adjust R213 just below the threshold of recurrent sweep. Set SYNC SELECTOR at LINE. Check that a slight rotation of the SYNC AMPLITUDE control in either direction causes the sweep to operate.

5. Replacement of Cathode-ray Tube

> **Caution**
>
> The cathode-ray tube should be handled with great care to prevent breakage, which might result in serious personal injury from flying glass. Do not employ force at any time. As an added precaution, it is advisable to wear safety goggles and gloves.

The following procedure is suggested for replacing the cathode-ray tube.

Step 1. Turn off power; remove cabinet or dust cover.

Step 2. Remove bezel held by four screws at front panel.

Step 3. Remove the cathode-ray tube socket.

Step 4. Loosen the cathode-ray tube clamp.

Step 5. Remove tube through front-panel opening.

Step 6. Install new tube through front-panel opening, and replace the bezel.

Step 7. Tighten the cathode-ray tube clamp.

Step 8. Replace the tube socket.

Step 9. Apply power and check the sweep; if not horizontal, loosen the cathode-ray tube clamp and rotate tube as required. CAUTION: HIGH VOLTAGE EXISTS ON CRT SOCKET. USE EXTREME CAUTION. Tighten clamp, being careful not to rotate tube in so doing.

TABLE 4-1
TROUBLE SHOOTING CHART

I. POWER SUPPLY AND CRT CIRCUITRY

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
1-1 Pilot indicator fails to light	1-1a Line cord not plugged into a live outlet	1-1a Trace line failure
	1-1b Pilot indicator lamp open	1-1b Replace
	1-1c Blown primary fuse (F604)	1-1c Check and replace
	1-1d Blown secondary heater fuse (F603)	1-1d Check and replace
	1-1e POWER switch defective	1-1e Place an ohmmeter across prongs at line cord and check continuity in the ON position; resistance should measure approximately 5 ohms
1-2 Line fuse blows instantly when POWER switch is turned on	1-2a Short in primary circuit	1-2a See 1-1e for checking procedure
1-3 B+ fuse (F601) blows after approximately one minute when POWER switch is turned ON	1-3a Defective low-voltage supply	**Warning** PERSONAL CONTACT WITH THE +390-VOLT SUPPLY MAY PROVE *FATAL* 1-3a (1) Make resistance check as follows:

Supply	Resistance to Ground	
	Type 340	Type 341
+390V	300K	70K
+150V	50K	60K

(2) Check that C601-A, C601-B, and C601-C are not shorted to ground

(3) Check voltage and resistance of V601 and V602 as per Table 4-2 or 4-3. Refer to the over-all schematic for checking other components

TABLE 4-1
TROUBLE SHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
1-4 No spot on cathode-ray tube screen	1-4a Spot might be depositioned due to a defective amplifier stage	1-4a To check, see 2-1a and 3-1b
	1-4b Spot might be depositioned due to a disconnection between the amplifier and the deflection plates	1-4b Check that the X DIR and Y DIR deflection plugs are properly connected at rear of cabinet
	1-4c Defective negative high-voltage supply (V501 and V502)	1-4c Tube replacement should be tried first. Measure voltage and resistance of V501 and V502 per Tables 4-2 and 4-3
	1-4d Defective low-voltage supply	1-4d The low voltages are required for application to the r-f power oscillator (V501). See 1-2b
	1-4e Defective cathode-ray tube	1-4e Check to see if tube is lit or feel for warmth. Caution—HV
	1-4f CRT not properly seated in its socket	1-4f Check to see that CRT is properly seated in socket
1-5 Output voltages "very low"	1-5a C602 may be defective	1-5a C602 has been selected to resonate with T601. If replacement is necessary, replace it with one having the same color dot stamped on the end of laminations (SOLA)
1-6 Output voltage varies. Line voltage within tolerance	1-6a Line frequency varies	1-6a T601 is intended for use with 60-cycle power line mains. Changes in the frequency of the supply voltage will be directly reflected in the output voltage. A change of about 1.8% in output voltage will occur for every 1% change in input frequency, and in the same direction as the frequency change
1-7 Excessive spot size variation as it is positioned over the screen (non-uniform focus)	1-7a ASTIG ADJ improperly set	1-7a Refer to paragraph entitled "Service Adjustments for the Cathode-ray Tube" in this Section
1-8 Uniformity of trace brightness varies with INTENSITY settings	1-8a Stray pick-up at Z INPUT terminal (idle connector or cable is coupled to terminals)	1-8a Short out Z INPUT

TABLE 4-1

TROUBLE SHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
	1-8b Also, r-f on trace will give this effect (intensity markers). Hum in supply	1-8b Check filter capacitors C501 and C502; replace if necessary
1-9 R-F pick-up	1-9a Loose r-f shield or cover on the r-f supply	1-9a Check and tighten if necessary
1-10 Bright spot at left side of screen	1-10a Defective beam gate circuit (V402)	1-10a Tube replacement should be tried first. V & R measurements of V402 should be taken with respect to cathode (pins 3 or 8). Refer to the over-all schematic for checking other components
	2. HORIZONTAL DEFLECTION CIRCUITRY (X-AXIS)	
2-1 No sweep, X SELECTOR at RECUR SWEEP	2-1a Spot might be depositioned due to a defective horizontal amplifier stage	2-1a To check, short together the plates of V303. If spot returns to center, one or more horizontal amplifier stages are defective. See 2-1b for tracking down this trouble
	2-1b Defective X amplifier	2-1b (1) To check, patch the TEST SIG to X INPUT, set X SELECTOR for minimum attenuation and (X) AMPLITUDE fully CCW (2) If trace appears, X amplifier is O.K. (3) If trace does not appear, try the one-at-a-time method of replacing the following tubes: V301 through V303; V304 (Type 341 only) NOTE: The original tube should be restored to its socket if not found to be defective (4) If tube replacement fails to clear up the trouble, make a voltage and resistance check. When checking V & R, use Table 4-2 for Type 340 and Table 4-3 for Type 341
2-2 No sweep; X SELECTOR at RECUR SWEEP. Horizontal deflection circuit checks okay.	2-2a MODE adjustment (R213) improperly set	2-2a Refer to the paragraph entitled "Service Adjustments for the Sync and Sweep Circuits" in this Section for the proper checking procedure

TABLE 4-1
TROUBLE SHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
	2-2b Defective gate circuitry (V202-A and 203)	2-2b Check tubes; take voltage and resistance measurements per Table 4-2 for Type 340, Table 4-3 for Type 341
	2-2c Defective sweep circuitry (V204)	2-2c See 2-2b
	2-2d Junction of R226 and R227 not tied to ground in RECUR SWEEP position	2-2d Check X SELECTOR switch; section S301-4F, which shunts R226 to ground in RECUR position
	2-2e Recurrent sweep gate turn-on path defective	2-2e Check continuity of path from junction of R227 and R228 to the grid (pin 2) of V202-A
	2-2f No continuity from sweep circuit to horizontal amplifier	2-2f Check continuity from junction of R221 and R222 to grid (pin 2) of V301-A. This checks the continuity of the shielded cable between the sweep and horizontal circuits; also checks X SELECTOR switch, sections S301-3R and S301-3F
2-3 No sweep in any one range of the SWEEP RANGE switch. (X SELECTOR at RECUR SWEEP)	2-3a Short in the associate sweep range capacitor. Note: (Open capacitor will cause a low frequency range to shift to highest range i.e. 6K-30K)	2-3a <table><tr><th>SWEEP RANGE at</th><th>Replace Defective Capacitor</th></tr><tr><td>6K—30K</td><td>C210</td></tr><tr><td>1200—6K</td><td>C211</td></tr><tr><td>250—1200</td><td>C212</td></tr><tr><td>50—250</td><td>C213</td></tr><tr><td>10—50</td><td>C214</td></tr><tr><td>2—10</td><td>C215</td></tr></table>
	2-3b Defective SWEEP RANGE switch	2-3b Repair or replace
2-4 (SWEEP) VERNIER has little or no effect on sweep frequency	2-4a Shorted potentiometer (R223)	2-4a Check and replace
2-5 Non-linear sweep	2-5a Defective saw regulator (E202)	2-5a Replace

TABLE 4-1

TROUBLE SHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
2-6 Loss of sync	2-6a Sync phase splitter (V201-A) and amplifier (V201-B) defective	2-6a Check and replace. Check tube pin voltages and resistances per V & R Table
	2-6b SYNC SELECTOR switch is not in the proper position for the desired mode of operation	2-6b (1) Set SYNC SELECTOR switch at INTernal when X SELECTOR switch is set at either DRIVEN or RECURrent SWEEP (2) External sync signals may be employed if SYNC SELECTOR is set at EXTernal (3) If line frequency excitation is employed, SYNC SELECTOR should be set at LINE (4) If X SELECTOR is set for external signals (A-C, D-C or COAX), SYNC SELECTOR should be set at EXTernal. (SYNC AMPLITUDE should be set at "0")
	2-6c Shunting resistor (R208) across V202-B open (RECUR SWEEP only)	2-6c Check R208 and replace
2-7 Undesired intensity modulation of trace noted when X SELECTor is set for external signals	2-7a SYNC AMPLITUDE not set to "0"	2-7a Set to "0." This "Symptom" can be a "feature" if desired; see paragraph entitled "Gated-beam Operation," in Section 2, Operation
2-8 No sweep; X SELECTOR set at DRIVEN SWEEP	2-8a Defective X SELECTOR switch	2-8a To check, switch X SELECTOR to RECUR SWEEP (1) If sweep fails to appear, see 2-1 and 2-2 (2) If sweep appears, reset X SELECTOR back to DRIVEN SWEEP and see 2-8b
	2-8b Inadequate amplitude of sync initiation signal	2-8b Adjust SYNC AMPLITUDE control for the proper phase and amplitude of the synchronization signal. In addition, refer to Table 1-1, Technical Summary Sheet, for sync sensitivities

TABLE 4-1

TROUBLE SHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
2-9 Approximately 1/2 of sweep trace is missing	2-9a One of the horizontal amplifier stages is defective	2-9a See 2-1b
2-10 DRIVEN SWEEP does not cutoff when SYNC AMPLITUDE is set at "0"	2-10a MODE service adjustment (R213) improperly set	2-10a See 2-2a
2-11 DRIVEN or RECUR SWEEP O.K. Cannot position trace on screen when X SELECTOR is set for external signals	2-11a X D-C BAL control is set either fully CW or CCW and (X) AMPLITUDE is set fully CW	2-11a Set (X) AMPLITUDE fully CCW. Trace may now be positioned on screen regardless of X D-C BAL control setting
2-12 X SELECTOR is OFF. CRT spot shifts (left and right) with changes in setting of (X) AMPLITUDE control	2-12a When using horizontal amplifier for application of external signals, X D-C BAL control must be adjusted first	2-12a See "X D-C BAL Adjustment" in Section 2, Operation NOTE: For DRIVEN or RECUR SWEEP operation, X D-C BAL may be employed as a sweep position control, hence, the necessity for readjustment arises when using external signals
2-13 X SELECTOR set for external signals. No trace when set for A-C; O.K. for D-C	2-13a Input coupling capacitor open (C301) 2-13b Defective X SELECTOR switch	2-13a Replace 2-3b Check switch section S301-2R
2-14 X SELECTOR set at COAX for application of external signals (Type 341 only). No trace when set for A-C; O.K. for D-C	2-14a Input coupling capacitor open (C325) 2-14b Defective X SELECTOR switch	2-14a Replace 2-14b Check switch section S301-1R
2-15 Same as 2-14 except no trace for either A-C or D-C input	2-15a Defective shielded cable and/or connection	2-15a Check cable continuity (see over-all schematic)

TABLE 4-1

TROUBLE SHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
2-16 A 1KC square wave is distorted at any one range of the X SELECTOR switch (A-C or D-C)	2-16a Improper adjustment in the associate X SELECTOR compensation capacitor	2-16a See "Service Adjustments" paragraph in section 4 for the proper checking procedure
2-17 A 100KC square wave applied to X INPUT is distorted (Type 341 only)	2-17a High-frequency compensation capacitors improperly adjusted (C323 and C324)	2-17a See "Service Adjustments" paragraph in section 4 for the proper checking procedure

X SELECTOR at (A-C or D-C)	Capacitor Requiring Adjustment	
	Type 340	Type 341
0.1	None	Not Applicable
1	C305	None
10	C306	C305
100	C307	C306

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
3. VERTICAL DEFLECTION CIRCUITRY (Y-AXIS)		
3-1 An appropriate signal is applied to Y INPUT. No vertical displacement of the trace results	3-1a Trace might be depositioned due to setting of Y D-C BAL fully CW or CCW and (Y) AMPLITUDE fully CW	3-1a To check, set (Y) AMPLITUDE fully CCW. Trace can now be positioned on screen irrespective of Y D-C BAL setting
	3-1b Trace might be depositioned due to a defective amplifier stage	3-1b To check, short together the plates of V103. If spot returns to center one or more vertical amplifier stages are defective. See 3-1c for tracking down this trouble
	3-1c Defective vertical amplifier	3-1c (1) Try the one-at-a-time method of replacing the following tubes: V101 through V103; V104 (Type 341 only) NOTE: The original tube should be restored to its socket if not found to be defective (2) If tube replacement fails to clear up the trouble, make a voltage and resistance check. When checking V & R, use Table 4-2 for Type 340 and Table 4-3 for Type 341

TABLE 4-1

TROUBLE SHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	CURATIVE MEASURES
3-2 Ripple on trace	3-2a HUM BAL service adjustment(s) improperly set	3-2a Refer to the appropriate paragraph under "Service Adjustments" in Section IV for the proper checking procedure
3-3 No vertical signal when Y SELECTOR switch is set at A-C; signal is present when switch is set to D-C	3-3a Open input coupling capacitor (C101)	3-3a Replace
	3-3b Defective Y SELECTOR switch	3-3b Check switch section S101-2R
3-4 Y SELECTOR set at COAX, (Type 341 only) no signal at A-C; O.K. at D-C	3-4a Open input coupling capacitor (C125)	3-4a Replace
	3-4b Defective Y SELECTOR switch	3-4b Check switch section S101-1R
3-5 Same as 3-4 except no trace for either A-C or D-C input	3-5a Defective shielded cable and/or connection	3-5a Check cable continuity (see over-all schematic)
3 6 Intermittent or jumpy trace—with or without Y INPUT signal	3-6a Defective tube-to-socket contact or corrosion of tube pins	3-6a Check and clean **WARNING** PERSONAL CONTACT WITH THE +390-VOLT SUPPLY MAY PROVE *FATAL*
	3 6b High resistant PW (printed wiring) connections to PW pins	3-6b Check by exerting gentle pressure on various parts of the PW board to pin point the intermittency; when found, resolder pin(s) by hand
	3-6c High resistant PW connections between components and PW pins	3 6c Refer to preceding comment
	3-6d Broken resistor(s) or PW connections	3-6d Check for continuity while pressing or tapping component under suspicion

TABLE 4-1
TROUBLE SHOOTING CHART (Continued)

<table>
<tr><th>SYMPTOM</th><th>PROBABLE CAUSE</th><th>CURATIVE MEASURES</th></tr>
<tr><td>3-7 Y SELECTOR at OFF, CRT trace shifts (up and down) with changes in setting of (Y) AMPLITUDE control.</td><td>3-7a Y D-C BAL (R110) improperly adjusted</td><td>3-7a See "Y D-C BAL Adjustment" in Section 2, Operation</td></tr>
<tr><td>3-8 Excessive relative phase shift between vertical and horizontal amplifiers (Type 341 only)</td><td>3-8a Phase shift service adjustment improperly set (C118)</td><td>3-8a See the appropriate paragraph under "Service Adjustments" in Section 4 for the proper checking procedure</td></tr>
<tr><td>3-9 A 1KC square wave is distorted at any one range of the Y SELECTOR switch (A-C or D-C)</td><td>3-9a Improper adjustment in the associate Y SELECTOR compensation capacitor</td><td>3-9a See "Service Adjustments" paragraph in Section 4 for the proper checking procedure
<table>
<tr><th rowspan="2">Y SELECTOR at (A-C or D-C)</th><th colspan="2">Capacitor Requiring Adjustment</th></tr>
<tr><th>Type 340</th><th>Type 341</th></tr>
<tr><td>0.1</td><td>None</td><td>Not Applicable</td></tr>
<tr><td>1</td><td>C105</td><td>None</td></tr>
<tr><td>10</td><td>C106</td><td>C105</td></tr>
<tr><td>100</td><td>C107</td><td>C106</td></tr>
</table></td></tr>
<tr><td>3-10 A 100KC square wave applied to Y INPUT is distorted (Type 341 only)</td><td>3-10a High-frequency compensation capacitors improperly adjusted (C123 and C124)</td><td>3-10a See "Service Adjustments" paragraph in Section 4 for the proper checking procedure</td></tr>
</table>

TABLE 4-2
VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 340

Preset front-panel controls according to the following chart:

CONTROL	SETTING	CONTROL	SETTING	CONTROL	SETTING
INTENSITY	For normal trace	(X) AMPLITUDE	Fully CW	SWEEP RANGE	Any position
FOCUS	Focused trace	Y SELECTOR	OFF	VERNIER	Any position
X POSITION	To center trace	(Y) AMPLITUDE	Fully CW	X D-C BAL	For balanced condition
Y POSITION	To center trace	SYNC AMPLITUDE	0	Y D-C BAL	
X SELECTOR	OFF				

WARNING

PERSONAL CONTACT WITH THE +390-VOLT SUPPLY MAY PROVE *FATAL*

TYPE 340 VERTICAL AND HORIZONTAL AMPLIFIERS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V101 or V301	12AU7 YELLOW TIPPED	INPUT D-C AMPLIFIER	67V	0	3V	6.3 VAC		67V	0	3V		(1) Vertical amplifier tube reference symbols are the 100 series; for the horizontal amplifier, the 300 series. (2) Heaters of amplifiers are bootstrapped approximately 90 volts d-c above ground. (3) CRT spot is centered for all voltage measurements.
			100K	220K	1.7K	35K	35K	100K	220K	1.7K	35K	
V102 or V302	12AU7	D-C AMPLIFIER	120V	67V	69V	6.3 VAC		120V	67V	69V		
			80K	100K	33K	35K	35K	80K	100K	33K	35K	
V103 or V303	6BK7-A	VERTICAL OR HORIZONTAL DEFLECTION D-C AMPLIFIER	250V	120V	123V	6.3 VAC		250V	120V	123 V	0 Shield	
			320K	80K	12K	35K	35K	320K	80K	12K	0 Shield	

TABLE 4-2

VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 340 (Continued)

TYPE 340 SYNC AND SWEEP CIRCUITS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V201	12AX7	(A) SYNC PHASE SPLITTER	145V	6.5V	6.5V	└	┘	60V 6.3 VAC	0	0	┘	(1) All heaters are boot-strapped approximately 90 volts d-c above ground. (2) Pin 7 varies with SYNC AMPLITUDE setting.
		(B) SYNC AMPLIFIER	60K	2.2M	10K	35K	35K	170K	0 to 100K	0	35K	
V202	6U8	(A) 1/2 GATE GENERATOR	60V	58V	153V	└6.3 VAC┘		105V	62V	105V	60V	(1) Same as above except reference to pin 7. (2) Rotate MODE (service adjustment R213) fully CW to disable the gate generator when taking voltage measurements.
		(B) SERIES TRIGGERING DIODE	170K	200K	50K	35K	35K	62K	12K	62K	170K	
V203	6U8	(A) 1/2 GATE GENERATOR	390V	40V	153V	└6.3 VAC┘		153V	62V	160V	153V	
		(B) GATE CATHODE FOLLOWER	300K	530K	50K	35K	35K	60K	12K	56K	60K	
V204	12AT7	(A) POSITIVE SAW GENERATOR	150V*	155V	153V	└	┘	390V 6.3 VAC	150V*	158V	┘	(1) Same as above. (2) Pins 1 and 7 vary with VERNIER setting. (3) *Measure with meter of 20-megohm impedance (Simpson 260 on 1000 V scale) or Electronic voltmeter.
		(B) POSITIVE SAW CATHODE FOLLOWER	550K to 5M	60K	50K	35K	35K	300K	550K to 5M	36K	35K	

TABLE 4-2

VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 340 (Continued)

TYPE 340 CRT AND BEAM CIRCUITS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1 | 14	2	3	5	7	8	9	10	11	
V401	5AQP-	CATHODE-RAY TUBE	6.3 VAC	0	−5 to −65V	0 to 380V	1450V	1450V	1450V	1450V	1450V	WARNING HIGH VOLTAGE (1500 V)
			1.8M	1.7 to 1.8M	1.7M	1.2 to 1.6M	320K	320K	350K	320K	320K	(1) V & R measurements taken with respect to CRT cathode (yellow wire). (2) Heater is bootstrapped to −1200 V supply. (3) Pins 2 and 3 vary with INTENSITY setting. (4) Pin 5 varies with INTENSITY and FOCUS setting.
			1	2	3	4	5	6	7	8	9	
V402	12AU7	BEAM GATE GENERATOR	50V	3V	7V	6.3 VAC		15V	7.2V	7V	6.3 VAC	WARNING HIGH VOLTAGE (−1200 V) FROM TUBE PINS TO GROUND
			1.7M	1.8M	1.8M	1.8M	1.8M	1.7M	1.8M	1.8M	1.8M	(1) V & R measurements taken with respect to −1200 V supply (white wire). (2) Heater is bootstrapped to −1200 V supply.

TABLE 4-2

VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 340 (Continued)

TYPE 340 R-F SUPPLY CIRCUITS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V501	6AQ5	R-F POWER OSCILLATOR	−25V	0	└6.3 VAC┘		200V	100V				V & R measurements taken with respect to +150-volt supply.
			80K	50K	35K	35K	320K	90K				
V502	1X2A	HIGH-VOLTAGE RECTIFIER	DO NOT MEAS	DO NOT MEAS								PLATE CAP
												−1500 V
			45	45								1.8M

TYPE 340 LOW VOLTAGE POWER SUPPLY CIRCUIT

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V601	5Y3-GT	LOW-VOLTAGE RECTIFIER		415V	420 VAC	420 VAC		420 VAC		415V		Heater voltage measures 5 VAC between pins 2 & 8.
				300K	20	20		20		300K		
V602	0A2	150 V SUPPLY REGULATOR	150V	0		0	150V		0			
			50K	0		0	50K		0			

TABLE 4-3

VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 341

Preset front-panel controls according to the following chart:

CONTROL	SETTING	CONTROL	SETTING	CONTROL	SETTING
INTENSITY	For normal trace	(X) AMPLITUDE	Fully CW	VERNIER	Any position
FOCUS	Focused trace	Y SELECTOR	OFF	X D-C BAL	For balanced condition
X POSITION	To center trace	(Y) AMPLITUDE	Fully CW	Y D-C BAL	
Y POSITION	To center trace	SYNC AMPLITUDE	0		
X SELECTOR	OFF	SWEEP RANGE	Any position		

WARNING

PERSONAL CONTACT WITH THE +390-VOLT SUPPLY MAY PROVE *FATAL*

TYPE 341 VERTICAL AND HORIZONTAL AMPLIFIERS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V101 or V301	12AU7 YELLOW TIPPED	D-C AMPLIFIER	45V	6V	6.8V			45V	6V	6.8V		(1) Vertical amplifier tube reference symbols are the 100 series; for the horizontal amplifier, the 300 series. (2) Heaters of amplifiers are bootstrapped approximately 90 volts d-c above ground. (3) CRT spot is centered for all voltage measurements.
							6.3 VAC					
			90K	1.9K	1.6K	35K	35K	90K	1.9K	1.6K	35K	
V102 or V302	12AU7	D-C AMPLIFIER	110V	45V	48V			110V	45V	48V		
							6.3 VAC					
			70K	90K	10K	35K	35K	70K	90K	10K	35K	
V103 or V303	6BK7-A	VERTICAL OR HORIZONAL DEFLECTION D-C AMPLIFIER	260V	110V	113V			260V	110V	113V	0	
						6.3 VAC						
			90K	70K	12K	35K	35K	90K	70K	12K	0	
V104 or V304	12AU7 YELLOW TIPPED	INPUT D-C CATHODE FOLLOWER	155V	0	6V			155V	0	6V		
							6.3 VAC					
			50K	220K	1.9K	35K	35K	50K	220K	1.9K	35K	

TABLE 4-3

VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 341 (Continued)

TYPE 341 SYNC AND SWEEP CIRCUITS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V201	12AX7	(A) SYNC PHASE SPLITTER	145V	6.5V	6.5V			60V 6.3 VAC	0	0		(1) All heaters are boot-strapped approximately 90 volts d-c above ground. (2) Pin 7 varies with SYNC AMPLITUDE setting.
		(B) SYNC AMPLIFIER	70K	2.2M	10K	35K	35K	170K	0 to 100K	0	35K	
V202	6U8	(A) 1/2 GATE GENERATOR	60V	58V	153V	6.3 VAC		105V	62V	105V	60V	(1) Same as above except reference to pin 7. (2) Rotate MODE (service adjustment R213) fully CW to disable the gate generator when taking voltage measurements.
		(B) SERIES TRIGGERING DIODE	170K	200K	60K	35K	35K	72K	12K	72K	170K	
V203	6U8	(A) 1/2 GATE GENERATOR	390V	40V	153V	6.3 VAC		153V	62V	160V	153V	
		(B) GATE CATHODE FOLLOWER	70K	530K	60K	35K	35K	75K	12K	56K	75K	
V204	12AT7	(A) POSITIVE SAW GENERATOR	150V*	155V	153V			390V 6.3 VAC	150V*	158V		(1) Same as above. (2) Pins 1 and 7 vary with VERNIER setting. (3) *Measure with meter of 20-megohm impedance (Simpson 260 on 1000 V scale) or Electronic voltmeter.
		(B) POSITIVE SAW CATHODE FOLLOWER	550K to 5M	60K	60K	35K	35K	70K	550K to 5M	36K	35K	

TABLE 4-3

VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 341 (Continued)

TYPE 341 CRT AND BEAM GATE CIRCUITS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1 | 14	2	3	5	7	8	9	10	11	
V401	5AQP-	CATHODE-RAY TUBE	6.3 VAC	0	−5 to −65V	0 to 380V	1450V	1450V	1450V	1450V	1450V	WARNING HIGH VOLTAGE (1500 V)
			1.8M	1.7 to 1.8M	1.7M	1.2 to 1.6M	90K	90K	65K	90K	90K	(1) V & R measurements taken with respect to CRT cathode (yellow wire). (2) Heater is bootstrapped to −1200 V supply. (3) Pins 2 and 3 vary with INTENSITY setting. (4) Pin 5 varies with INTENSITY and FOCUS settings.
			1	2	3	4	5	6	7	8	9	
V402	12AU7	BEAM GATE GENERATOR	50V	3V	7V	6.3 VAC		15V	7.2V	7V	6.3 VAC	WARNING HIGH VOLTAGE (−1200 V) FROM TUBE PINS TO GROUND
			1.7M	1.8M	1.8M	1.8M	1.8M	1.7M	1.8M	1.8M	1.8M	(1) V & R measurements taken with respect to −1200 V supply (white wire). (2) Heater is bootstrapped to −1200 V supply.

TABLE 4-3

VOLTAGE AND RESISTANCE MEASUREMENTS FOR TYPE 341 (Continued)

TYPE 341 R-F SUPPLY CIRCUITS

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V501	6AQ5	R-F POWER OSCILLATOR	–25V	0	└6.3 VAC┘		250V	200V				V & R measurements taken with respect to +150-volt supply.
			90K	60K	35K	35K	70K	420K				
V502	1X2A	HIGH-VOLTAGE RECTIFIER	DO NOT MEAS	DO NOT MEAS								PLATE CAP –1500 V
			45	45								1.8M

TYPE 341 LOW VOLTAGE POWER SUPPLY CIRCUIT

TUBE			PIN NUMBERS									COMMENTS
Symbol	Type	Function	1	2	3	4	5	6	7	8	9	
V601	5Y3-GT	LOW-VOLTAGE RECTIFIER		415V	420 VAC	420 VAC		420 VAC		415V		Heater voltage measures 5 VAC between pins 2 & 8.
				70K	20	20		20		70K		
V602	0A2	150 V SUPPLY REGULATOR	150V	0		0	150V		0			
			60K	0		0	50K		0			

TABLE 4-4
ADJUSTMENTS TO BE MADE WHEN REPLACING TUBES

Tubes not shown require no readjustment upon replacement

Tube Reference Symbol	Tube Type	Service Adjustments (Refer to paragraph 4)	
		Type 340	Type 341
V101	12AU7-Y	ASTIG ADJ (R118), HUM BAL (R603) and Hum Harmonic Trimmer (C119)	ASTIG ADJ (R416), H-F Compensation (C123 and C124), and Phase Shift Trimmer (C118)
V102	12AU7	ASTIG ADJ (R118)	Same as V101
V103	6BK7-A	Same as V102	Same as V101
V104	12AU7-Y	Not applicable	Same as V101
V204	12AT7	MODE (R213)	MODE (R213)
V301	12AU7-Y	ASTIG ADJ (R118), HUM BAL (R603) and Hum Harmonic Trimmer (C319)	ASTIG ADJ (R416), H-F Compensation (C323 and C324), and Phase Shift Trimmer (C118)
V302	12AU7	ASTIG ADJ (R118)	Same as V301
V303	6BK7-A	Same as V302	Same as V301
V304	12AU7-Y	Not applicable	Same as V301
V501	6AQ5	HV ADJ (R503)	HV ADJ (R503)
V502	1X2-A	HV ADJ (R503)	HV ADJ (R503)
V601	5Y3-GT	HV ADJ (R503)	HV ADJ (R503)
V602	OA2	HV ADJ (R503) and MODE (R213)	HV ADJ (R503) and MODE (R213)

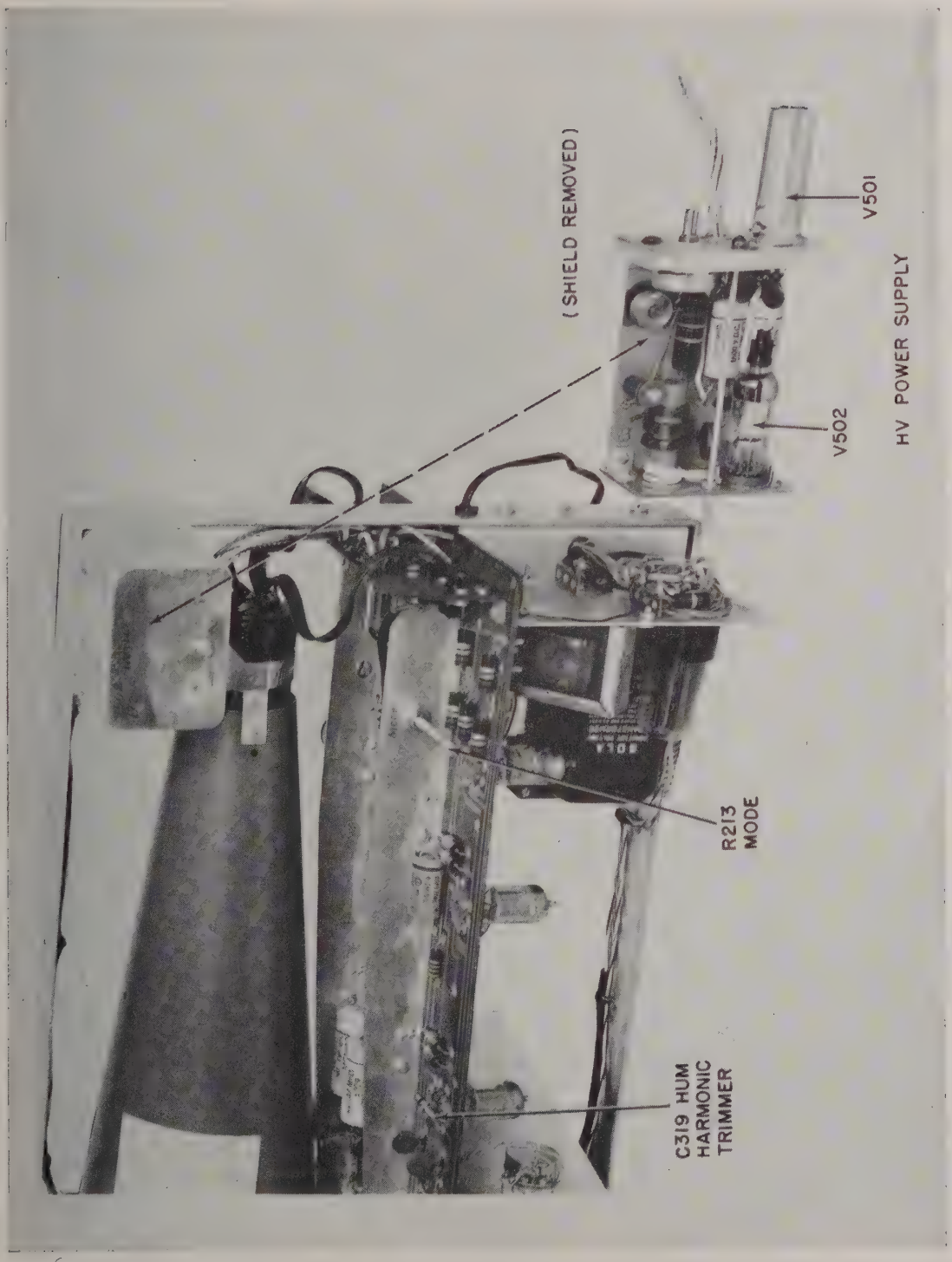


FIGURE 4-2. TYPE 340: TUBE LOCATION AND SERVICE ADJUSTMENTS

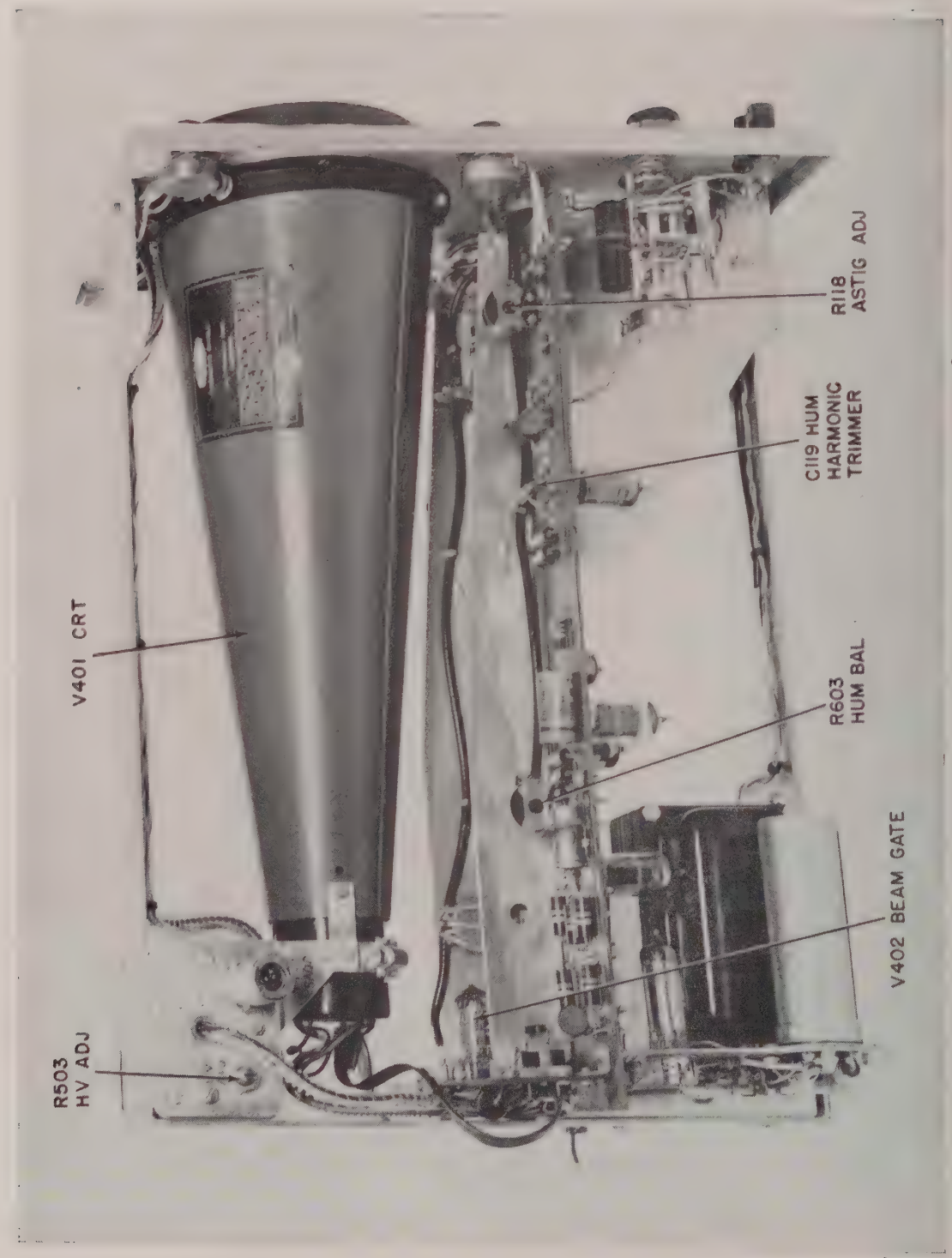


FIGURE 4-3. TYPE 340: TUBE LOCATION AND SERVICE ADJUSTMENTS

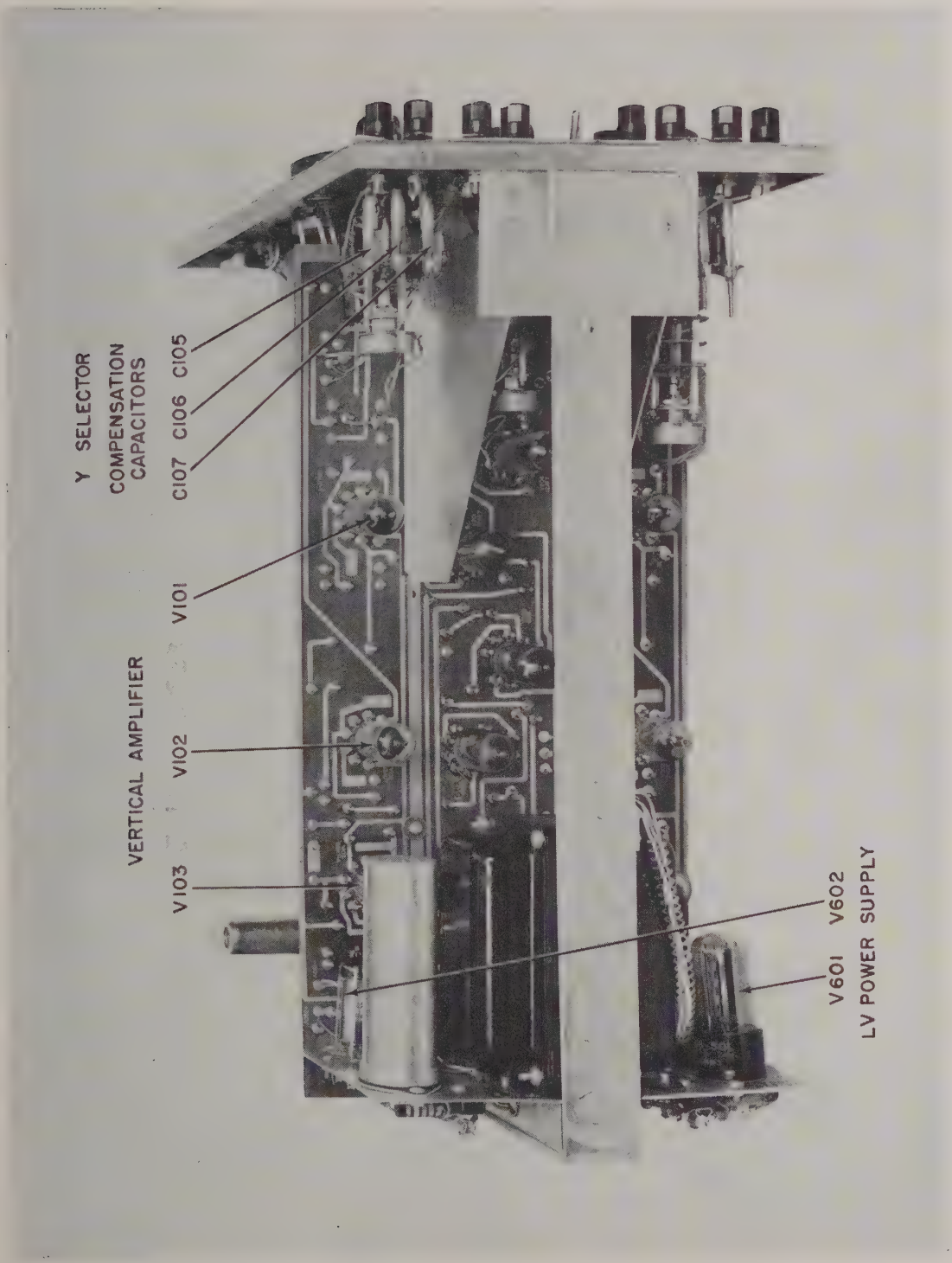


FIGURE 4-4. TYPE 340: TUBE LOCATION AND SERVICE ADJUSTMENTS

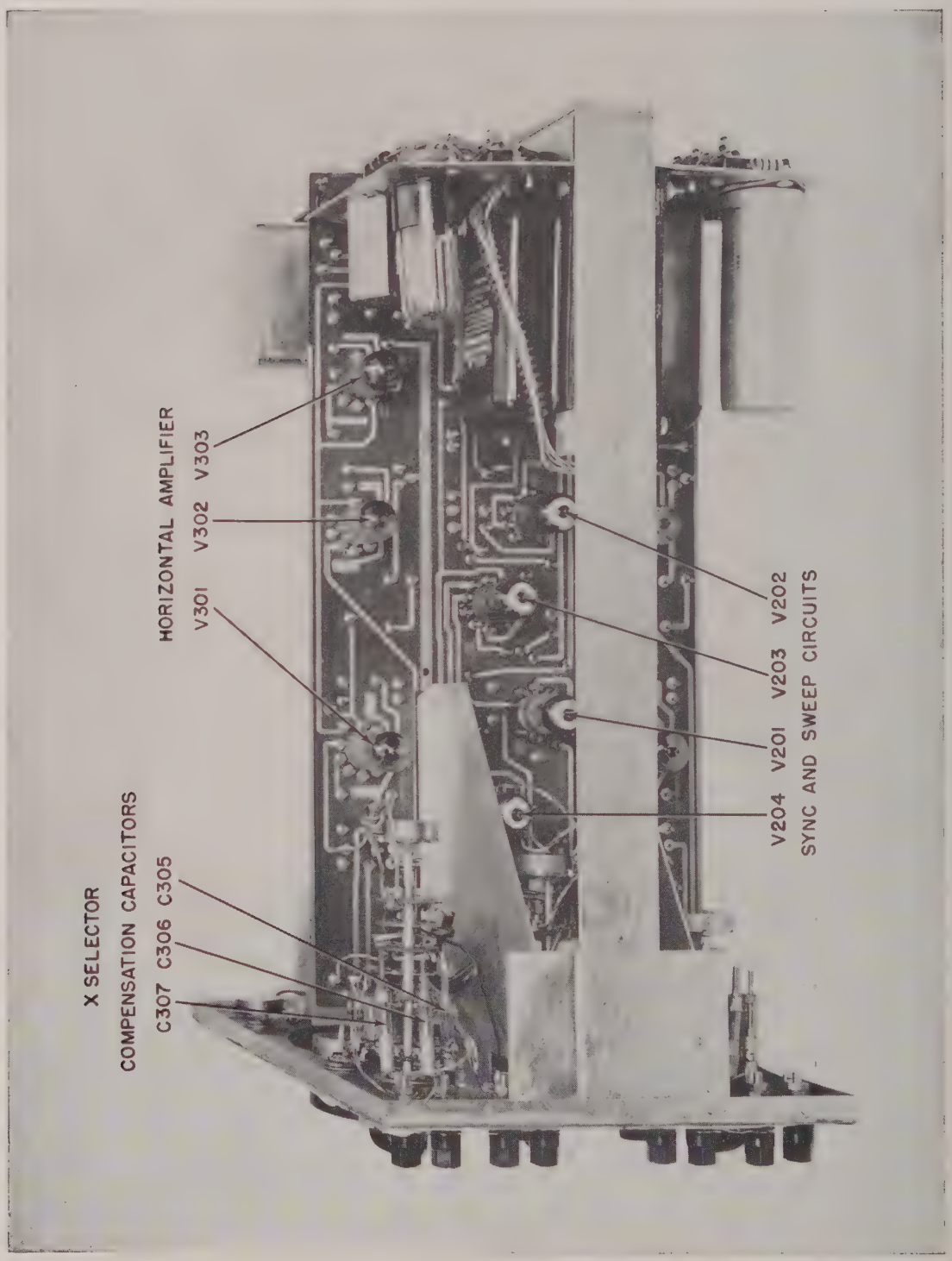


FIGURE 4-5. TYPE 340: TUBE LOCATION AND SERVICE ADJUSTMENTS

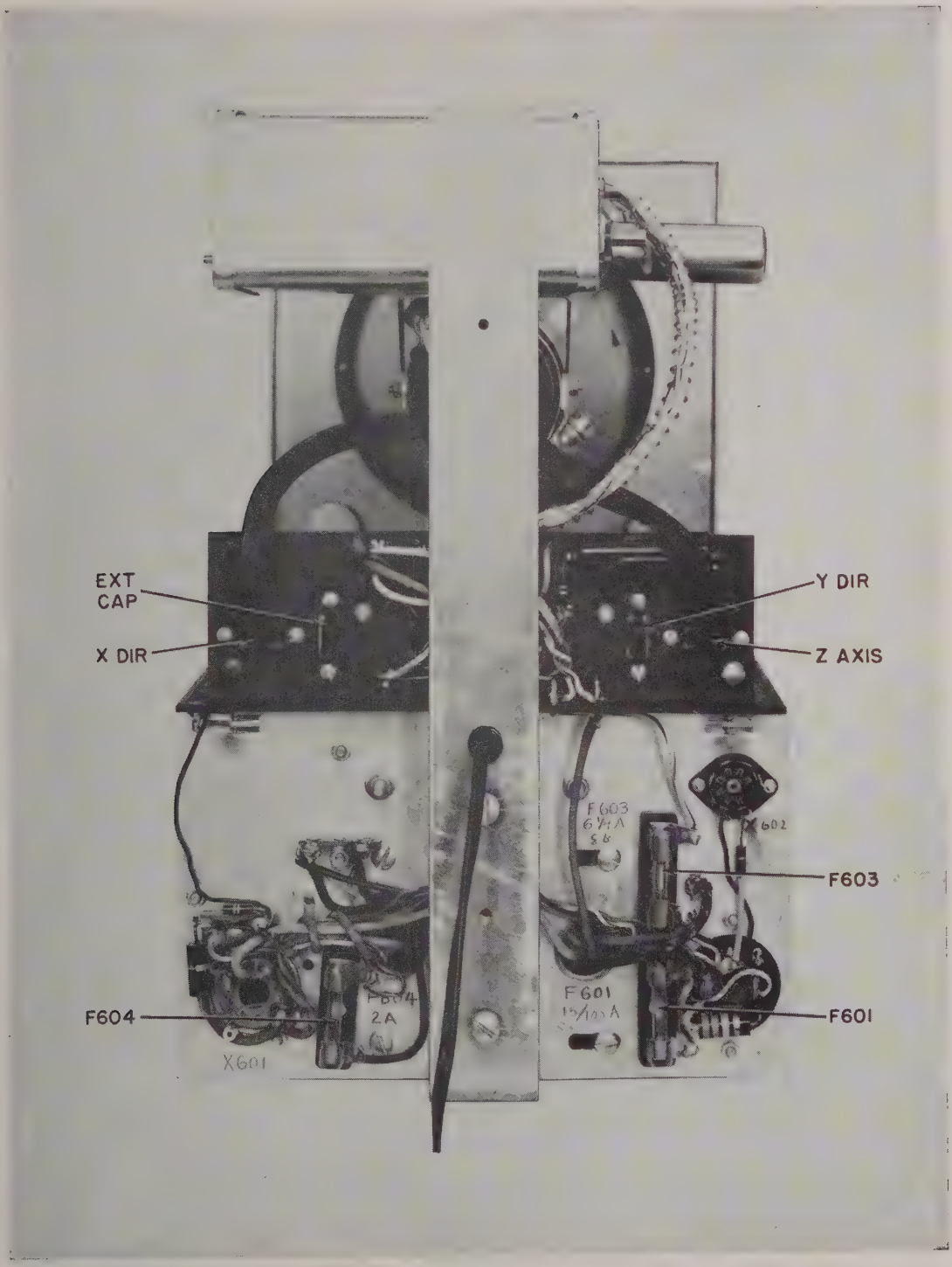


FIGURE 4-6. TYPE 340: FUSE LOCATION AND REAR-PANEL FACILITIES

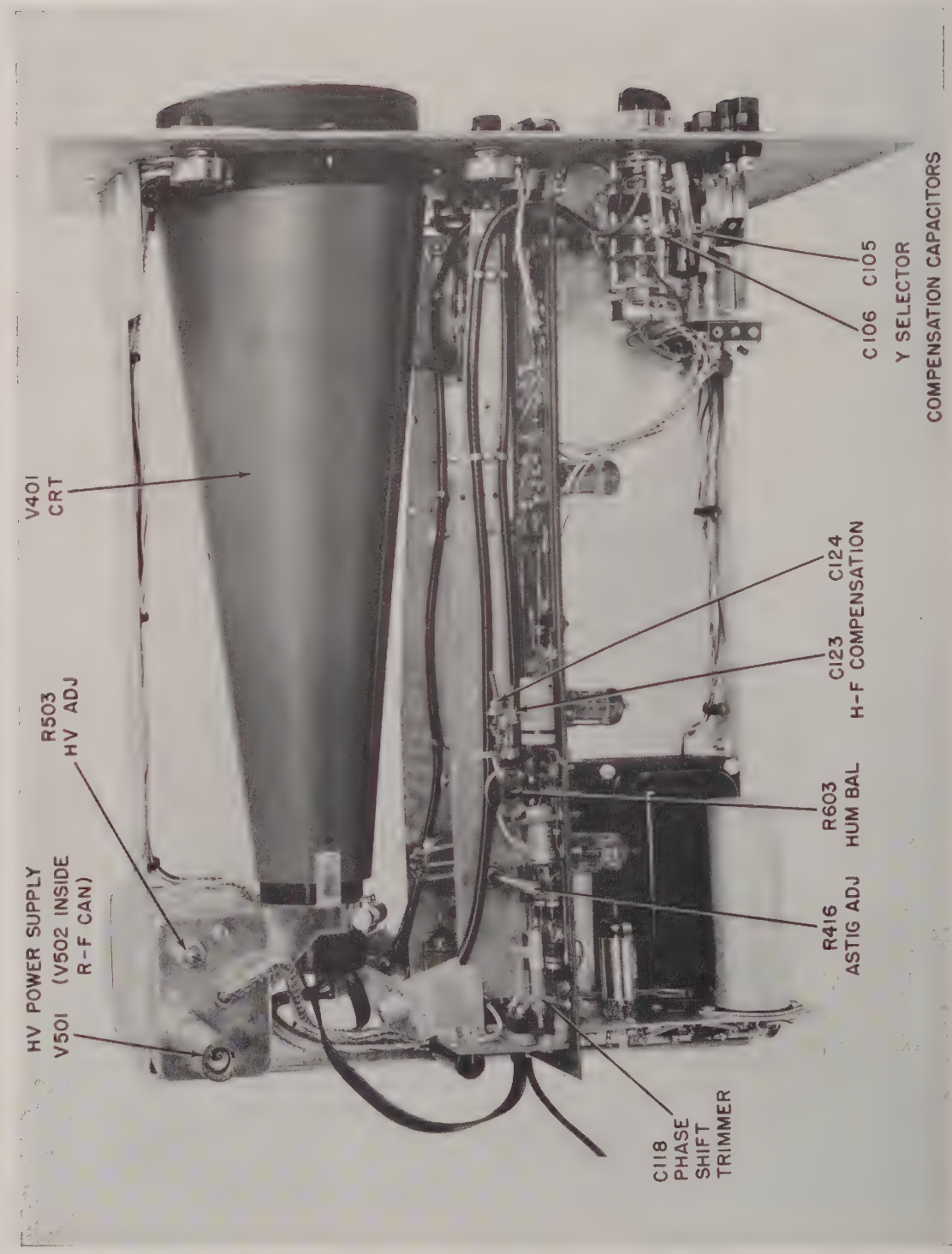


FIGURE 4-7. TYPE 341-R: TUBE LOCATION AND SERVICE ADJUSTMENTS

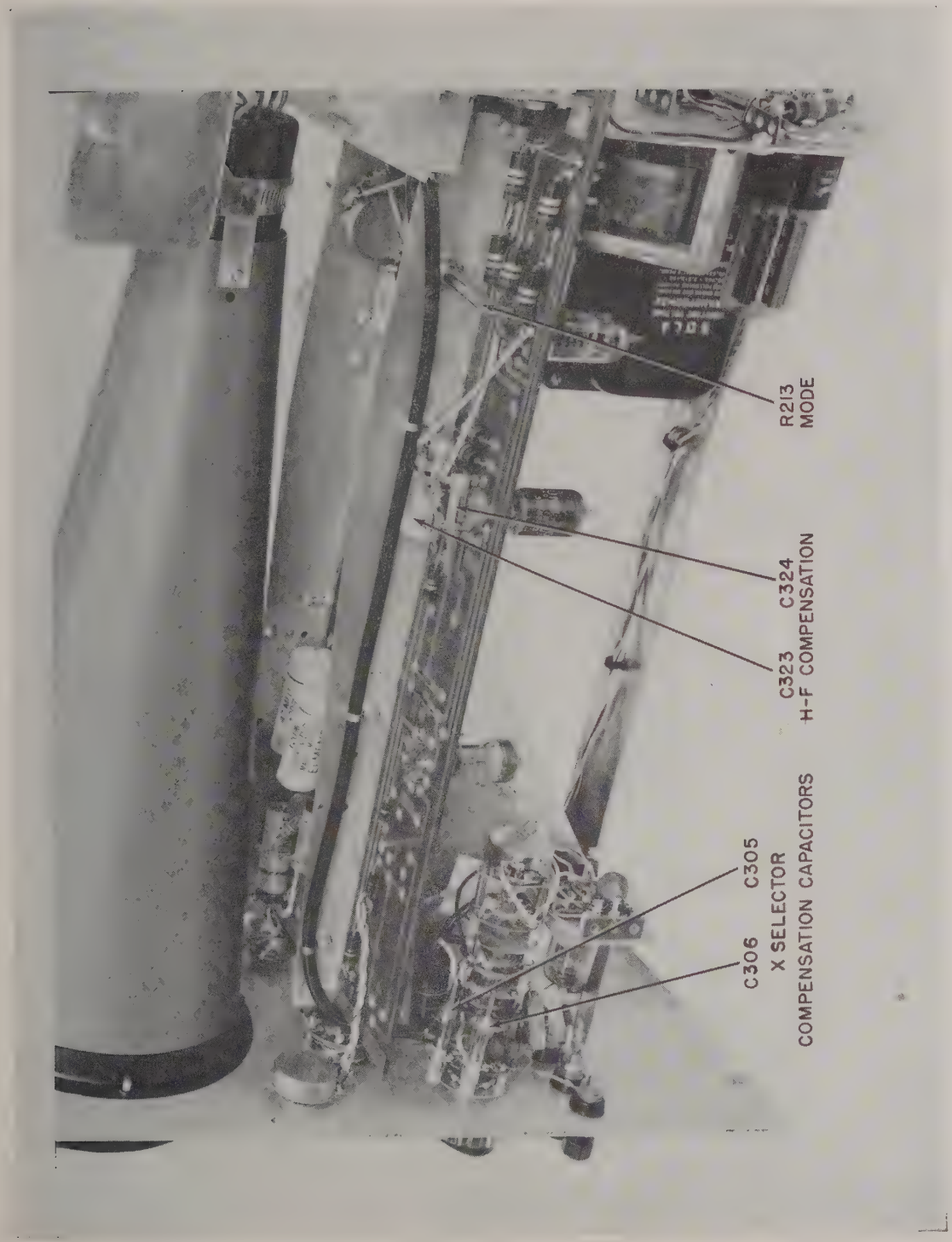


FIGURE 4-8. TYPE 341-R: TUBE LOCATION AND SERVICE ADJUSTMENTS

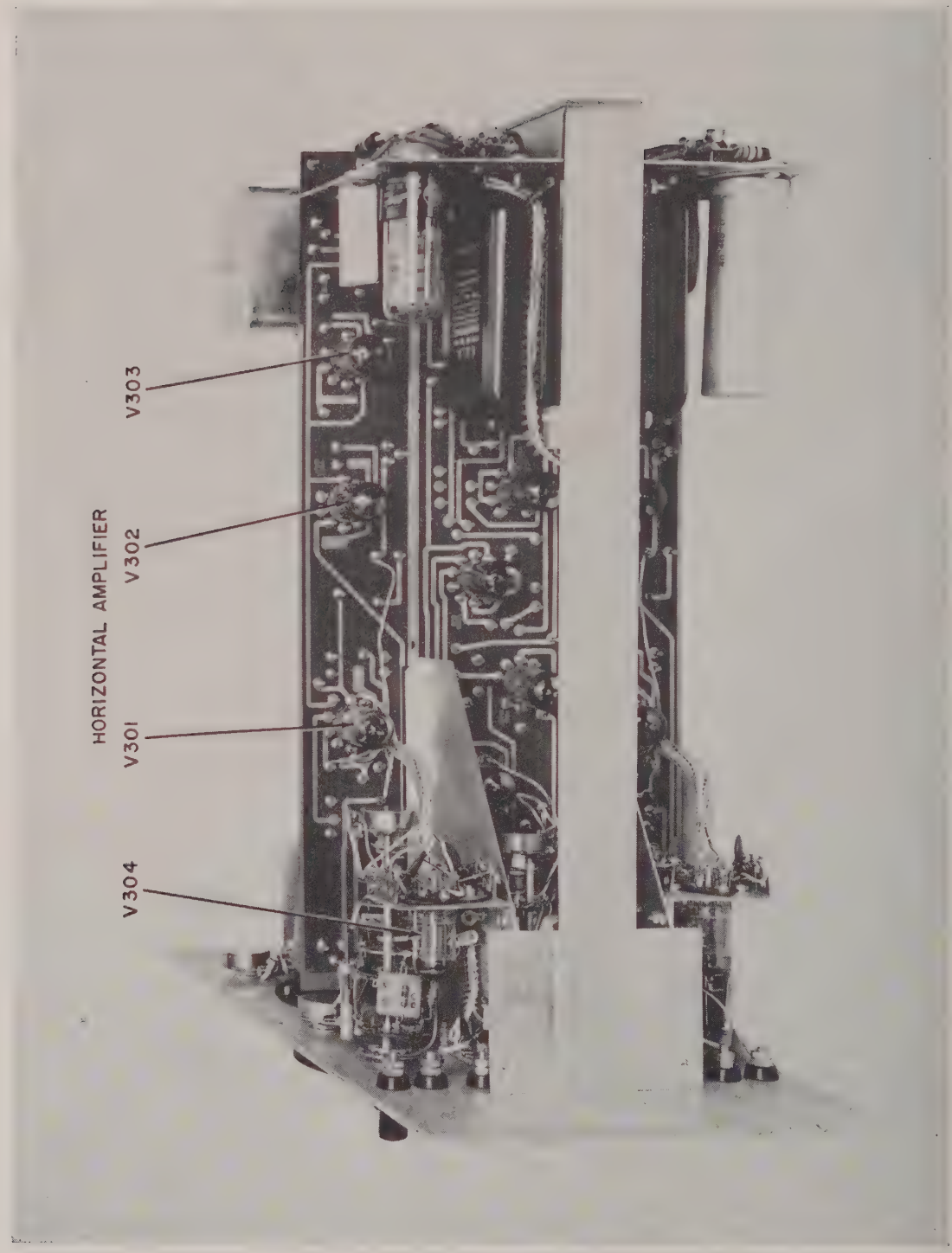


FIGURE 4-9. TYPE 341-R: TUBE LOCATION

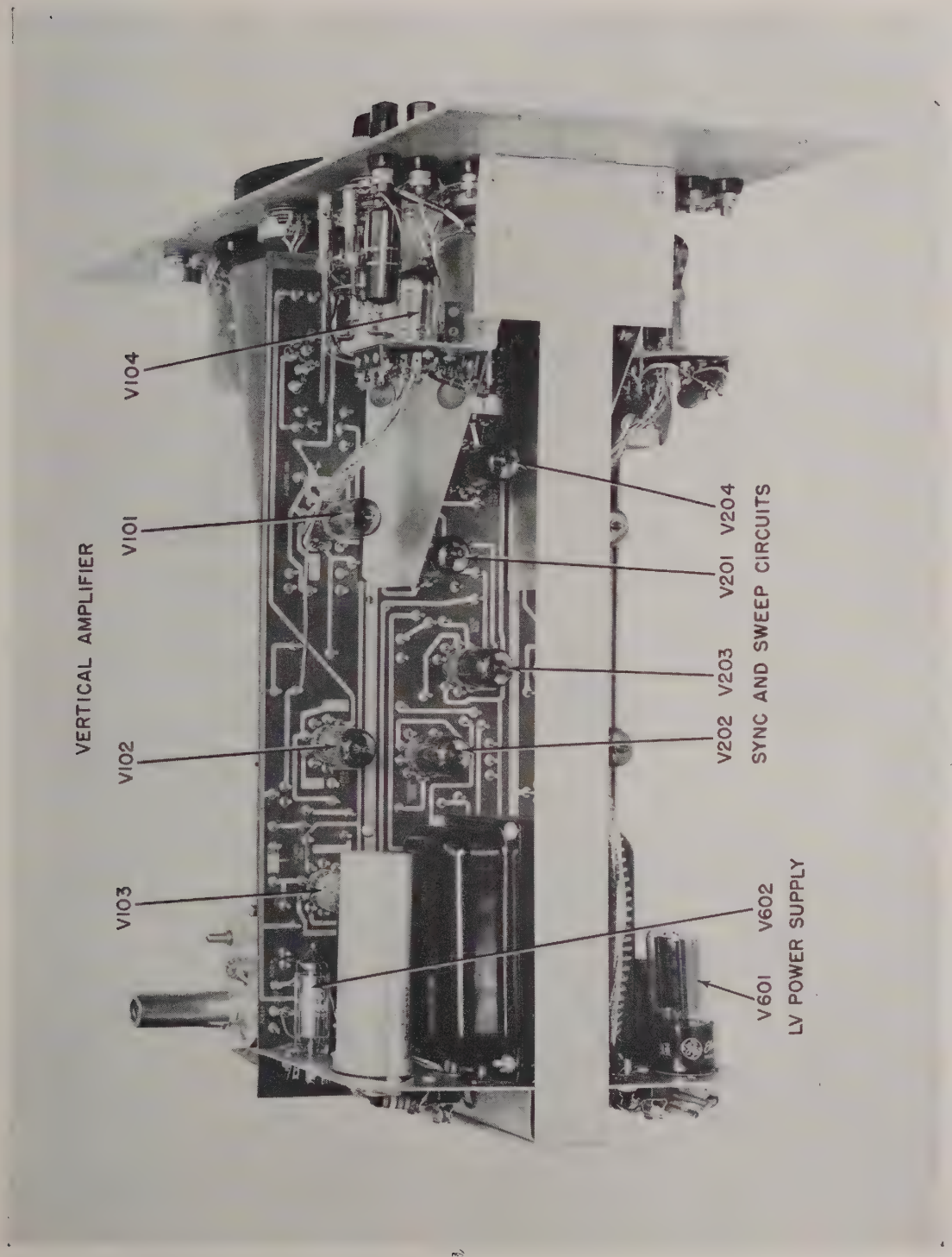


FIGURE 4-10. TYPE 341-R: TUBE LOCATION

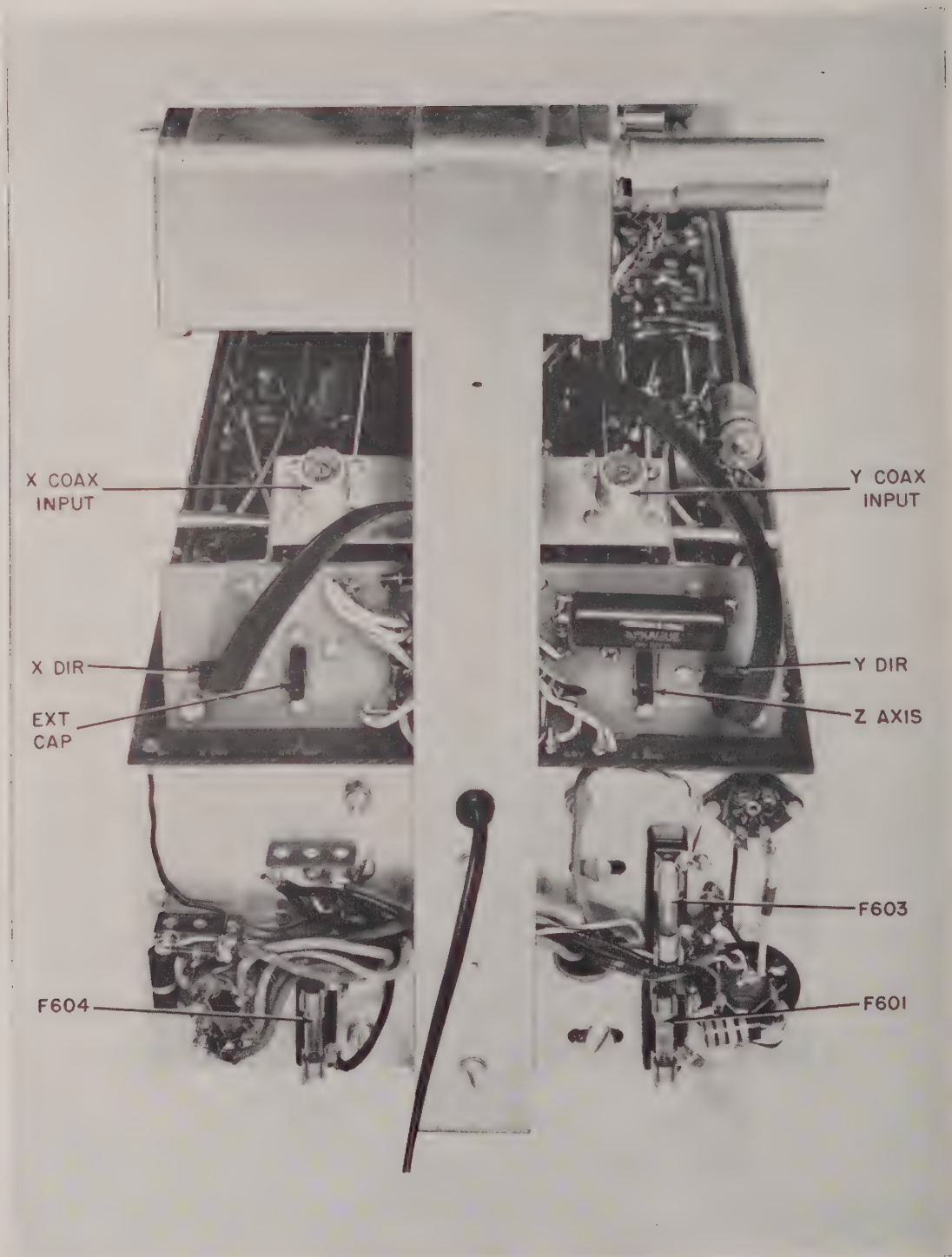


FIGURE 4-11. TYPE 341-R: FUSE LOCATION AND REAR-PANEL FACILITIES

SECTION 5
ELECTRICAL PARTS LIST AND SCHEMATICS

Type 340/340-R Cathode-Ray Oscillograph

Symbol	Part Number	Description
CAPACITORS		
(All capacitors are fixed, ceramic, ±10%, 500 V unless otherwise specified)		
C101	0312 8220	paper, 0.1 µf, ±20%, 600 V
C102	0302 0390	mica, 47 µµf
C103	0302 9430	mica, 820 µµf
C104	0303 3650	mica, 8200 µµf, 300 V
C105 to C107	0316 9631	variable, glass, 1-12 µµf, 600 V
C108 & C109	0301 9650	0.01 µf, +80 −20%, 450 V
C112	0314 8800	electrolytic, 4 µf, +100 −10%, 250 V
C118	0301 9650	0.01 µf, +80 −20%, 450 V
C201	0301 5340	paper, 1 µf, +30 −20%, 200 V
C202	0300 4170	paper, 0.05 µf, +20 −10%, 600 V
C203 & C204	0314 0400	paper, 0.47 µf, ±20%, 200 V
C205	0315 2510	composition, 4.7 µµf, ±20%
C207	0302 0390	mica, 47 µµf
C208	0301 9650	0.01 µf, +80 −20%, 450 V
C210	0302 0310	mica, 10 µµf
C211	0302 0450	mica, 150 µµf
C212	0302 9440	mica, 1000 µµf
C213	0303 3640	mica, 6800 µµf, 300 V
C214	0314 0330	paper, 0.033 µf. ±20%, 200 V
C215	0314 0380	paper, 0.22 µf, ±20%, 200 V
C216	0301 9650	0.01 µf, +80 −20%, 450 V
C301	0312 8220	paper, 0.1 µf, ±20%, 600 V
C302	0302 0390	mica, 47 µµf
C303	0302 9430	mica, 820 µµf
C304	0303 3650	mica, 8200 µµf, 300 V
C305 to C307	0316 9631	variable, glass, 1-12 µµf, 600 V
C308 & C309	0301 9650	0.01 µf, +80 −20%, 450 V
C312	0314 8800	electrolytic, 4 µf, +100 −10%, 250 V
C401	0316 8650	22 µµf, 2000 V
C402	0316 4930	0.01 µf, ±20%, 2000 V
C501 & C502	0316 4930	0.01 µf, ±20%, 2000 V
C503	0314 6090	1.5 µµf, ±0.5 µµf, 5000 V
C504	0312 7620	paper, 0.1 µf, ±20%, 400 V
C505	0301 9650	0.01 µf, +80 −20%, 450 V
C601 A,B,C	0312 6030	electrolytic, 40/80/20 µf, +50 −10%, 450 V
C602		part of T601, paper, 0.85 µf, 850 V
C603 to C605	0301 5340	paper, 1 µf, 200 V
REGULATORS, NEON		
E201 & E202	1200 8931	lamp, glow
FUSES		
F601	1100 0880	0.15 ampere, slow blow
F603	1100 2180	6.25 amperes, slow blow
F604	1100 0780	2 amperes
LAMP		
I601	1200 7700	neon, NE51, with built-in resistor for use on 75 to 250 volts ac or dc
CONNECTORS, ELECTRICAL, FEMALE		
J101 & J102	5101 2551	post, binding, black
J103	5100 7080	post, binding, black, non-captive head
J104	0904 1290	receptacle, 2 round contacts
J201 & J202	5101 2551	post, binding, black
J203	0904 1290	receptacle, 2 round contacts
J301 & J302	5101 2551	post, binding, black
J303	5100 7080	post, binding, black, non-captive head
J304	0904 1290	receptacle, 2 round contacts
INDUCTORS		
L501	2100 3810	fixed, 9100 µh
L601	2100 4301	fixed, 10 h
CONNECTORS, ELECTRICAL, MALE		
P203 & P401	0904 1460	plug, 2 round contacts
RESISTORS		
(Resistance values in ohms; K=thousand, M=million. All resistors are fixed, composition, ±10%, ½ W unless otherwise specified)		
R101	0204 1270	2M, ±5%
R102	0204 1050	240K, ±5%
R103	0204 0790	20K, ±5%
R104	0204 0550	2K, ±5%
R105 & R106	0204 1270	2M, ±5%
R107 & R108	0203 2560	220K, ±20%
R109	0203 1780	1200
R110	0101 1210	variable, 1K, ±20%
R111 & R112	0203 7930	22K, 2 W
R113	0203 4950	33K, 1 W
R114	0106 7700	variable, 100K, ±20% (part of switch assembly, S101)
R115	0203 1780	1200
R118	0106 6190	variable, 10K, ±20%
R119	0203 4940	27K, 1 W
R120	0101 1210	variable, 1K, ±20%
R121 & R122	0203 7930	22K, 2 W
R123	0203 7900	12K, 2 W
R126 & R127	0203 7900	12K, 2 W
R128 & R129	0203 2020	120K
R130	0203 2010	100K
R131 & R132	0203 7900	12K, 2 W

section 5
parts list and schematics

Symbol	Part Number	Description
R201	0203 2080	390K
R202	0203 2170	2.2M
R203	0203 1880	8200
R204	0203 1800	1800
R205	0203 1890	10K
R206	0101 4200	variable, 200K, ±20%
R207	0203 8020	120K, 2 W
R208	0203 2000	82K
R209	0203 7850	4700, 2 W
R210	0203 2140	1.2M
R211	0203 2130	1M
R212	0203 4900	12K, 1 W
R213	0106 7900	variable, 10K, ±20%, 2 W
R214	0203 2130	1M
R215	0203 2140	1.2M
R216	0203 7850	4700, 2 W
R217	0203 4980	56K, 1 W
R218	0203 1840	3900
R219	0203 2070	330K
R220	0203 5050	220K, 1 W
R221	0203 1130	510K, ±5%
R222	0203 0760	15K, ±5%
R223	0106 4910	variable, 5M, ±20% (part of switch assembly, S202)
R224	0203 1090	360K, ±5%
R225	0203 8010	100K, 2 W
R226	0203 1770	1K
R227	0203 6730	11K, ±5%, 2 W
R228	0210 9380	wire wound, 25K, ±5%, 5 W
R229	0203 0450	750, ±5%
R230	0203 6930	75K, ±5%, 2 W
R231	0203 8060	270K, 2 W
R232	0203 8070	330K, 2 W
R236	0203 1770	1K
R301	0204 1270	2M, ±5%
R302	0204 1050	240K, ±5%
R303	0204 0790	20K, ±5%
R304	0204 0550	2K, ±5%
R305 & R306	0204 1270	2M, ±5%
R307 & R308	0203 2560	220K, ±20%
R309	0203 1780	1200
R310	0101 1210	variable, 1K, ±20%
R311 & R312	0203 7930	22K, 2 W
R313	0203 4950	33K, 1 W
R314	0106 7700	variable, 100K, ±20% (part of switch assembly, S301)
R315	0203 1780	1200
R319	0203 4950	33K, 1 W
R320	0101 1210	variable, 1K, ±20%
R321 & R322	0203 7930	22K, 2 W
R323	0203 7900	12K, 2 W
R326 & R327	0203 7900	12K, 2 W
R331 & R332	0203 7900	12K, 2 W
R401	0203 1920	18K
R402	0203 1030	200K, ±5%
R403	0203 2090	470K
R404	0203 1980	56K
R405	0203 1000	150K, ±5%
R406	0203 2090	470K
R407	0203 1980	56K
R408	0203 2170	2.2M
R409	0203 1950	33K
R410	0203 2020	120K
R411	0101 1340	variable, 500K, ±20%
R413	0101 1340	variable, 500K, ±20%
R414	0203 2140	1.2M
R501	0203 4940	27K, 1 W
R502	0203 1950	33K
R503	0100 9860	variable, 100K, ±20%
R601	0203 1960	39K
R602	0203 1940	27K
R603	0106 6090	variable, 500, ±20%
R604	0203 1930	22K
R605	0203 8130	1M, 2 W
R606	0203 1690	220
R607	0203 8070	330K, 2 W

SWITCHES

(All rotary switches are phenolic and the angle of throw is 30° between positions unless otherwise specified)

S101	0500 5994	rotary, 2 sections, 3 poles, 9 positions
	0500 5993	assembly, consists of S101 and R114
S201	0500 9662	rotary, 60°, 1 section, 1 pole, 3 positions
S202	0500 9674	rotary, 2 sections, 1 pole, 7 positions
	0500 9673	assembly, consists of S202 and R223
S301	0501 0452	rotary, 4 sections, 1 pole, 3 positions
	0501 0451	assembly, consists of S301 and R314
S601	0500 1130	toggle, SPST

TRANSFORMERS

T501	2000 7311	rf, high voltage
T601*	2000 7292	power, 60-cycle
	2000 9911	power, 50-cycle
	2000 9871	power, 50 to 400 cycles

*Depending on sales order

TUBES

V101	2500 0130	12AU7 (yellow coded)
V102	2500 0130	12AU7 (red coded)
V103	2500 8560	6BK7-A
V201	2500 1500	12AX7
V202 & V203	2500 7310	6U8
V204	2500 1530	12AT7
V301	2500 0130	12AU7 (yellow coded)
V302	2500 0130	12AU7 (red coded)
V303	2500 8560	6BK7-A
V401*	2500 8700	5AQP1
	2500 8710	5AQP2
	2500 8720	5AQP7
	2500 8730	5AQP11

*Depending on sales order

V402	2500 0130	12AU7 (green coded)
V501	2500 0340	6AQ5
V502	2500 6490	1X2-A
V601	2500 0220	5Y3-GT
V602	2500 0300	OA2

CABLE

W601	5026 9641	assembly, electrical, shielded, #18/2 AWG, 72 inches

Type 341/341-R Cathode-Ray Oscillograph

Symbol	Part Number		Description
CAPACITORS			
(All capacitors are fixed, ceramic, ±10%, 500 V unless otherwise specified)			
C101	0312	8220	paper, 0.1 µf, ±20%, 600 V
C102	0302	0390	mica, 47 µµf
C103	0302	9430	mica, 820 µµf
C105 & C106	0316	9631	variable, glass, 1-12 µµf, 600 V
C108 & C109	0301	9650	0.01 µf, +80 −20%, 450 V
C112	0314	8800	electrolytic, 4 µf, +100 −10%, 250 V
C118	0316	9631	variable, glass, 1-12 µµf, 600 V
C123 & C124	0316	3600	variable, glass, 0.5 µµf, 500 V
C125	0312	8160	paper, 0.01 µf, ±20%, 600 V
C126	0301	9650	0.01 µf, +80 −20%, 450V
C201	0312	7620	paper, 0.1 µf, ±20%, 400 V
C202	0300	4170	paper, 0.05 µf, +20 −10%, 600 V
C203 & C204	0314	0400	paper, 0.47 µf, ±20%, 200 V
C205	0315	2510	composition, 4.7 µµf, ±20%
C207	0302	0390	mica, 47 µµf
C208	0301	9650	0.01 µf, +80 −20%, 450 V
C210	0302	0310	mica, 10 µµf
C211	0302	0450	mica, 150 µµf
C212	0302	9440	mica, 1000 µµf
C213	0303	3640	mica, 6800 µµf, 300 V
C214	0314	0330	paper, 0.033 µf, ±20%, 200 V
C215	0314	0380	paper, 0.22 µf, ±20%, 200 V
C216	0301	9650	0.01 µf, +80 −20%, 450 V
C301	0312	8220	paper, 0.1 µf, ±20%, 600 V
C302	0302	0390	mica, 47 µµf
C303	0302	9430	mica, 820 µµf
C305 & C306	0316	9631	variable, glass, 1-12 µµf, 600 V
C308 & C309	0301	9650	0.01 µf, +80 −20%, 450 V
C312	0314	8800	electrolytic, 4 µf, +100 −10%, 250 V
C323 & C324	0316	3600	variable, glass, 0.5 µµf, 500 V
C325	0312	8160	paper, 0.01 µf, ±20%, 600 V
C326	0301	9650	0.01 µf, +80 −20%, 450 V
C401	0316	8650	22 µµf, 2000 V
C402	0316	4930	0.01 µf, ±20%, 2000 V
C403	0301	9650	0.01 µf, +80 −20%, 450 V
C501 & C502	0316	4930	0.01 µf, ±20%, 2000 V
C503	0314	6090	1.5 µµf, ±0.5 µµf, 5000 V
C504	0312	7620	paper, 0.1 µf, ±20%, 400 V
C505	0301	9650	0.01 µf, +80 −20%, 450 V
C601 A,B,C	0312	6030	electrolytic, 40/80/20 µf, +50 −10%, 450 V
C602			part of T601, paper, 0.85 µf, 850 V
C603 to C605	0301	5340	paper, 1 µf, 200 V
REGULATORS, NEON			
E201 & E202	1200	8931	lamp, glow
FUSES			
F601	1100	0880	0.15 ampere, slow blow
F603	1100	2180	6.25 amperes, slow blow
F604	1100	0780	2 amperes
LAMP			
I601	1200	7700	neon, NE51, with built-in resistor for use on 75 to 250 volts ac or dc
CONNECTORS, ELECTRICAL, FEMALE			
J101 & J102	5101	7500	post, binding, black, captive head
J103	5100	7080	post, binding, black, non-captive head
J104	0904	1290	receptacle, 2 round contacts
J105	0900	5130	receptacle, rf, 1 round contact
J201 & J202	5101	7500	post, binding, black, captive head
J203	0904	1290	receptacle, 2 round contacts
J301 & J302	5101	7500	post, binding, black, captive head
J303	5100	7080	post, binding, black, non-captive head
J304	0904	1290	receptacle, 2 round contacts
J305	0900	5130	receptacle, rf, 1 round contact
J401	0904	1290	receptacle, 2 round contacts
INDUCTORS			
L501	2100	3810	fixed, 9100 µh
L601	2100	4301	fixed, 10 h
CONNECTORS, ELECTRICAL, MALE			
P101 & P301	0904	1300	plug, 2 round contacts
RESISTORS			
(Resistance values in ohms; K=thousand, M=million. All resistors are fixed, composition, ±10%, ½ W unless otherwise specified)			
R101	0204	1270	2M, ±5%
R102	0204	1050	240K, ±5%
R103	0204	0790	20K, ±5%
R105 & R106	0204	1270	2M, ±5%
R107 & R108	0203	2560	220K, ±20%
R110	0101	1210	variable, 1K, ±20%
R111 & R112	0203	0800	22K, ±5%
R113	0203	3790	20K, ±5%, 1 W
R119	0203	3720	10K, ±5%, 1 W
R120	0101	1210	variable, 1K, ±20%
R121 & R122	0203	7930	22K, 2 W
R123	0203	7900	12K, 2 W
R126 & R127	0203	7900	12K, 2 W
R130	0203	2010	100K
R131 & R132	0203	7900	12K, 2 W
R133 & R134	0204	1110	430K, ±5%
R135 & R136	0203	1800	1800
R137	0106	7710	variable, 10K, ±20% (part of switch assembly, S101)
R138	0203	1640	82
R139	0203	0520	1500, ±5%
R141 & R142	0203	1690	220
R143 to R145	0203	1770	1K
R201	0203	2080	390K
R202	0203	2170	2.2M
R203	0203	1880	8200
R204	0203	1800	1800
R205	0203	1890	10K
R206	0101	4200	variable, 200K, ±20%
R207	0203	8020	120K, 2 W

section 5
parts list and schematics

Symbol	Part Number	Description
R208	0203 2000	82K
R209	0203 7850	4700, 2 W
R210	0203 2140	1.2M
R211	0203 2130	1M
R212	0203 4900	12K, 1 W
R213	0106 7900	variable, 10K, ±20%, 2 W
R214	0203 2130	1M
R215	0203 2140	1.2M
R216	0203 7850	4700, 2 W
R217	0203 4980	56K, 1 W
R218	0203 1840	3900
R219	0203 2070	330K
R220	0203 5050	220K, 1 W
R221	0203 1130	510K, ±5%
R222	0203 0780	18K, ±5%
R223	0106 4910	variable, 5M, ±20% (part of switch assembly, S202)
R224	0203 1090	360K, ±5%
R225	0203 8010	100K, 2 W
R226	0203 1770	1K
R227	0203 6730	11K, ±5%, 2 W
R228	0210 9380	wire wound, 25K, ±5%, 5 W
R229	0203 0450	750, ±5%
R230	0203 6930	75K, ±5%, 2 W
R231	0203 8060	270K, 2 W
R232	0203 8070	330K, 2 W
R236	0203 1770	1K
R301	0204 1270	2M, ±5%
R302	0204 1050	240K, ±5%
R303	0204 0790	20K, ±5%
R305 & R306	0204 1270	2M, ±5%
R307 & R308	0203 2560	220K, ±20%
R310	0101 1210	variable, 1K, ±20%
R311 & R312	0203 0800	22K, ±5%
R313	0203 3790	20K, ±5%, 1 W
R319	0203 3720	10K, ±5%, 1 W
R320	0101 1210	variable, 1K, ±20%
R321 & R322	0203 7930	22K, 2 W
R323	0203 7900	12K, 2 W
R326 & R327	0203 7900	12K, 2 W
R331 & R332	0203 7900	12K, 2 W
R333 & R334	0204 1110	430K, ±5%
R335 & R336	0203 1800	1800
R337	0106 7710	variable, 10K, ±20% (part of switch assembly, S301)
R338	0203 1640	82
R339	0203 0520	1500, ±5%
R341 & R342	0203 1690	220
R343 to R345	0203 1770	1K
R401	0203 1920	18K
R402	0203 1030	200K, ±5%
R403	0203 2090	470K
R404	0203 1980	56K
R405	0203 1000	150K, ±5%
R406	0203 2090	470K
R407	0203 1980	56K
R408	0203 2170	2.2M
R409	0203 1950	33K
R410	0203 2020	120K
R411	0101 1340	variable, 500K, ±20%
R413	0101 1340	variable, 500 K, ±20%
R414	0203 2140	1.2M
R415	0203 4920	18K, 1 W
R416	0106 7900	variable, 10K, ±20%, 2 W
R417	0203 4920	18K, 1 W
R501	0203 4940	27K, 1 W
R502	0203 1950	33K
R503	0100 9860	variable, 100K, ±20%

Symbol	Part Number	Description
R601	0203 1960	39K
R602	0203 1940	27K
R603	0106 6090	variable, 500 ±20%
R604	0203 1930	22K
R605	0203 8130	1M, 2 W
R606	0203 1690	220
R607	0203 8070	330K, 2 W
R608	0210 6250	wire wound, 15K, ±5%, 10 W

SWITCHES

(All rotary switches are phenolic and the angle of throw is 30° between positions unless otherwise specified)

S101	0500 5994	rotary, 2 sections, 3 poles, 9 positions
	0501 0501	assembly, consists of S101 and R137
S201	0500 9662	rotary, 60°, 1 section, 1 pole, 3 positions
S202	0500 9674	rotary, 2 sections, 1 pole, 7 positions
	0500 9673	assembly, consists of S202 and R223
S301	0501 0452	rotary, 4 sections, 1 pole, 3 positions
	0501 0491	assembly, consists of S301 and R337
S601	0500 1130	toggle, SPST

TRANSFORMERS

T501	2000 7311	rf, high voltage
T601*	2000 7292	power, 60-cycle
	2000 9911	power, 50-cycle
	2000 9871	power, 50 to 400 cycles

*Depending on sales order

TUBES

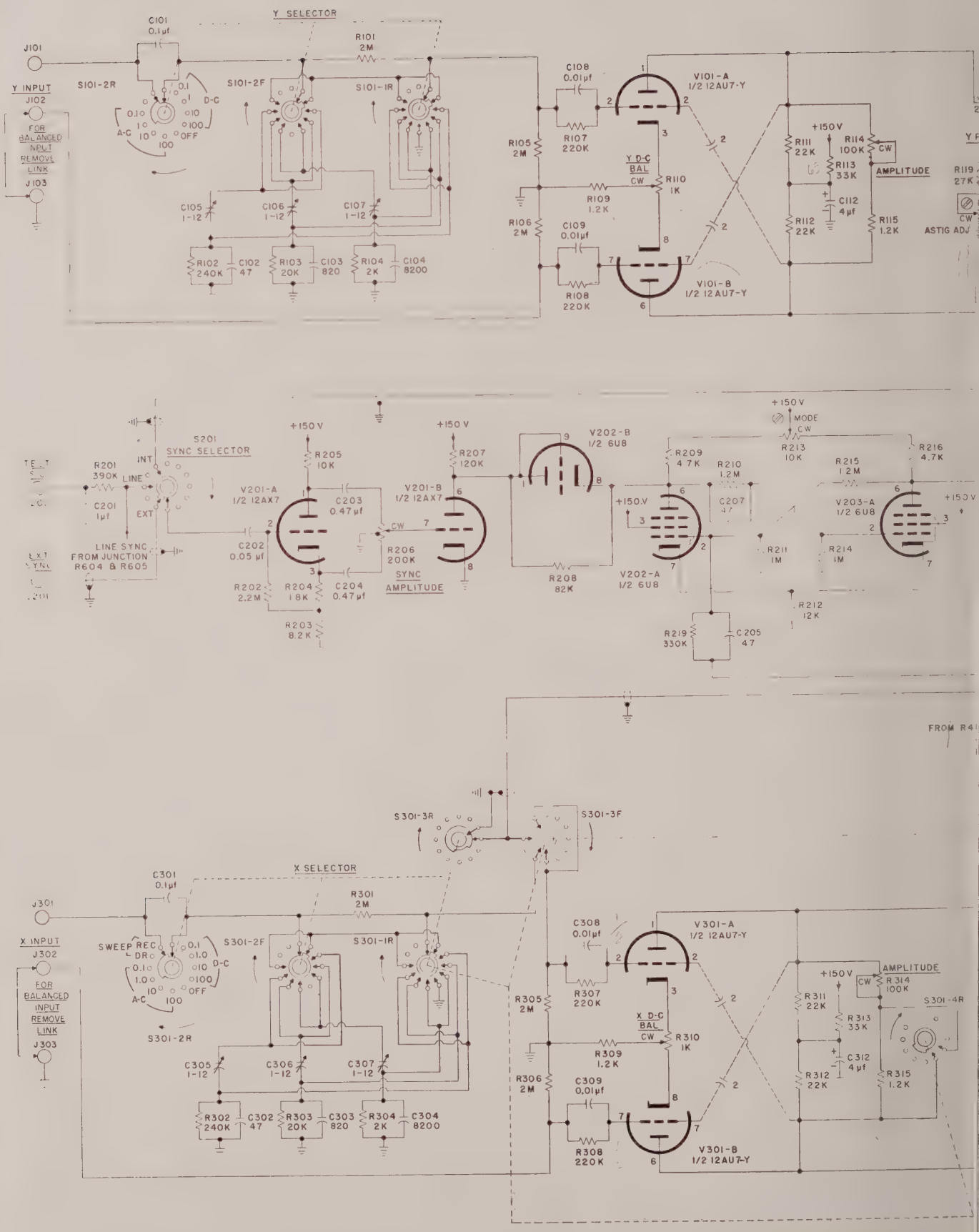
V101	2500 0130	12AU7 (yellow coded)
V102	2500 0130	12AU7 (red coded)
V103	2500 8560	6BK7-A
V104	2500 0130	12AU7 (yellow coded)
V201	2500 1500	12AX7
V202 & V203	2500 7310	6U8
V204	2500 1530	12AT7
V301	2500 0130	12AU7 (yellow coded)
V302	2500 0130	12AU7 (red coded)
V303	2500 8560	6BK7-A
V304	2500 0130	12AU7 (yellow coded)
V401*	2500 8700	5AQP1
	2500 8710	5AQP2
	2500 8720	5AQP7
	2500 8730	5AQP11

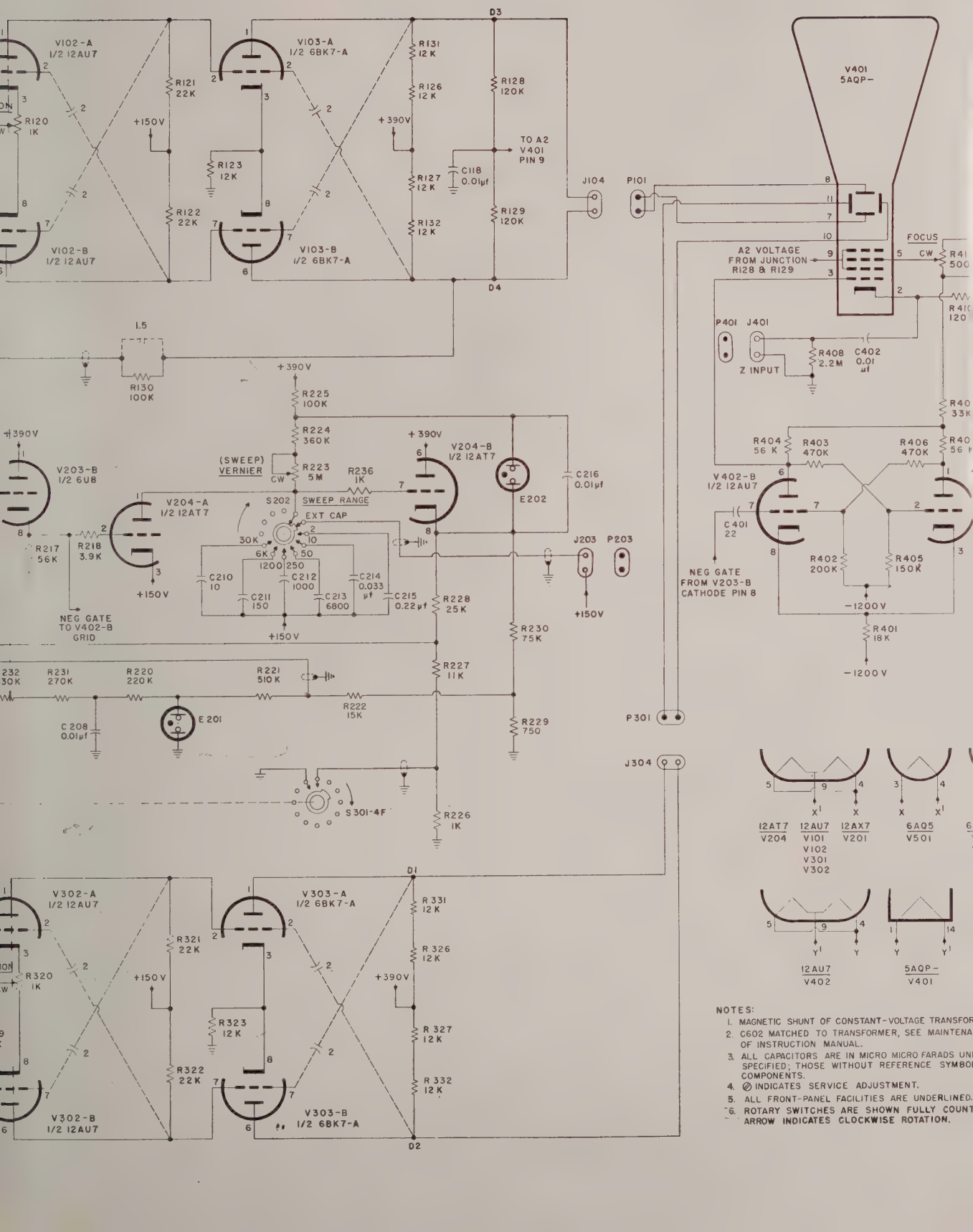
*Depending on sales order

V402	2500 0130	12AU7 (green coded)
V501	2500 0340	6AQ5
V502	2500 6490	1X2-A
V601	2500 0220	5Y3-GT
V602	2500 0300	OA2

CABLE

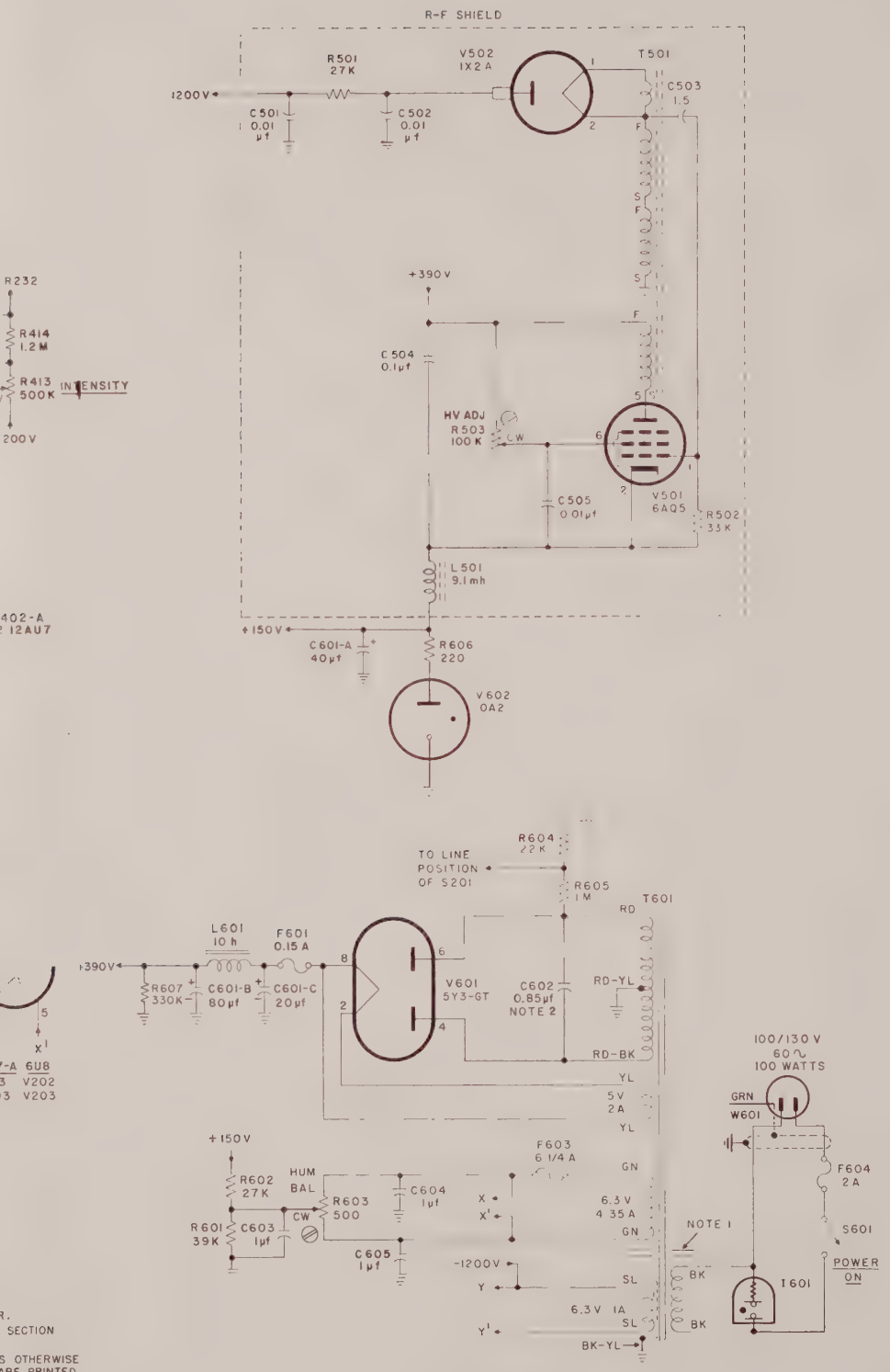
W601	5026 9641	assembly, electrical, shielded, #18/2 AWG, 72 inches


Y SELECTOR
J101
Y INPUT
J102
FOR BALANCED INPUT REMOVE LINK
J103
C101 0.1μf
R101 2M
S101-2R
S101-2F
S101-1R
C105 1-12
C106 1-12
C107 1-12
R102 240K
C102 47
R103 20K
C103 820
R104 2K
C104 8200
C108 0.01μf
R107 220K
V101-A 1/2 12AU7-Y
R105 2M
Y D-C BAL
R110 1K
R109 1.2K
R106 2M
C109 0.01μf
R108 220K
V101-B 1/2 12AU7-Y
+150V
R111 22K
R114 100K
R113 33K
AMPLITUDE
C112 4μf
R112 22K
R115 1.2K
R119 27K
ASTIG ADJ
S201
SYNC SELECTOR
INT
LINE
EXT
R201 390K
C201 1μf
LINE SYNC FROM JUNCTION R604 & R605
R205 10K
V201-A 1/2 12AX7
C203 0.47μf
C202 0.05 μf
R202 2.2M
R204 1.8K
C204 0.47μf
R203 8.2K
R207 120K
V201-B 1/2 12AX7
R206 200K
SYNC AMPLITUDE
V202-B 1/2 6U8
R208 82K
V202-A 1/2 6U8
R209 4.7K
R210 1.2M
C207 47
R211 1M
R212 12K
R219 330K
C205 47
MODE
R213 10K
R215 1.2M
R216 4.7K
V203-A 1/2 6U8
R214 1M
S301-3R
S301-3F
X SELECTOR
J301
X INPUT
J302
FOR BALANCED INPUT REMOVE LINK
J303
SWEEP REC
DR
C301 0.1μf
R301 2M
S301-2F
S301-1R
S301-2R
C305 1-12
C306 1-12
C307 1-12
R302 240K
C302 47
R303 20K
C303 820
R304 2K
C304 8200
C308 0.01μf
R307 220K
V301-A 1/2 12AU7-Y
R305 2M
X D-C BAL
R310 1K
R309 1.2K
R306 2M
C309 0.01μf
R308 220K
V301-B 1/2 12AU7-Y
R311 22K
R313 33K
C312 4μf
R312 22K
R314 100K
S301-4R
R315 1.2K



NOTES:

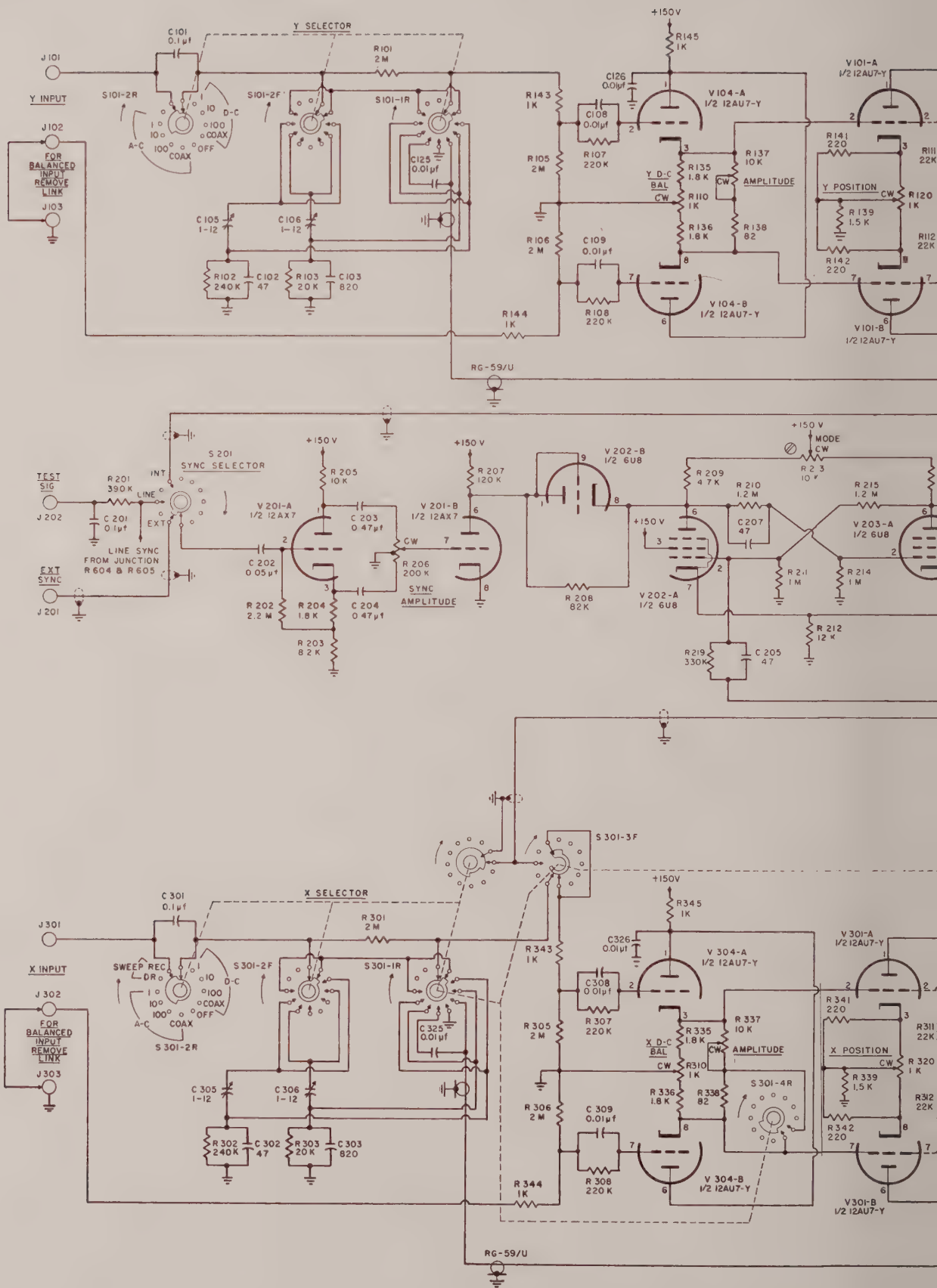
1. MAGNETIC SHUNT OF CONSTANT-VOLTAGE TRANSFOR
2. C602 MATCHED TO TRANSFORMER, SEE MAINTENA OF INSTRUCTION MANUAL.
3. ALL CAPACITORS ARE IN MICRO MICRO FARADS UN SPECIFIED; THOSE WITHOUT REFERENCE SYMBO COMPONENTS.
4. ⊘ INDICATES SERVICE ADJUSTMENT.
5. ALL FRONT-PANEL FACILITIES ARE UNDERLINED.
6. ROTARY SWITCHES ARE SHOWN FULLY COUNT ARROW INDICATES CLOCKWISE ROTATION.

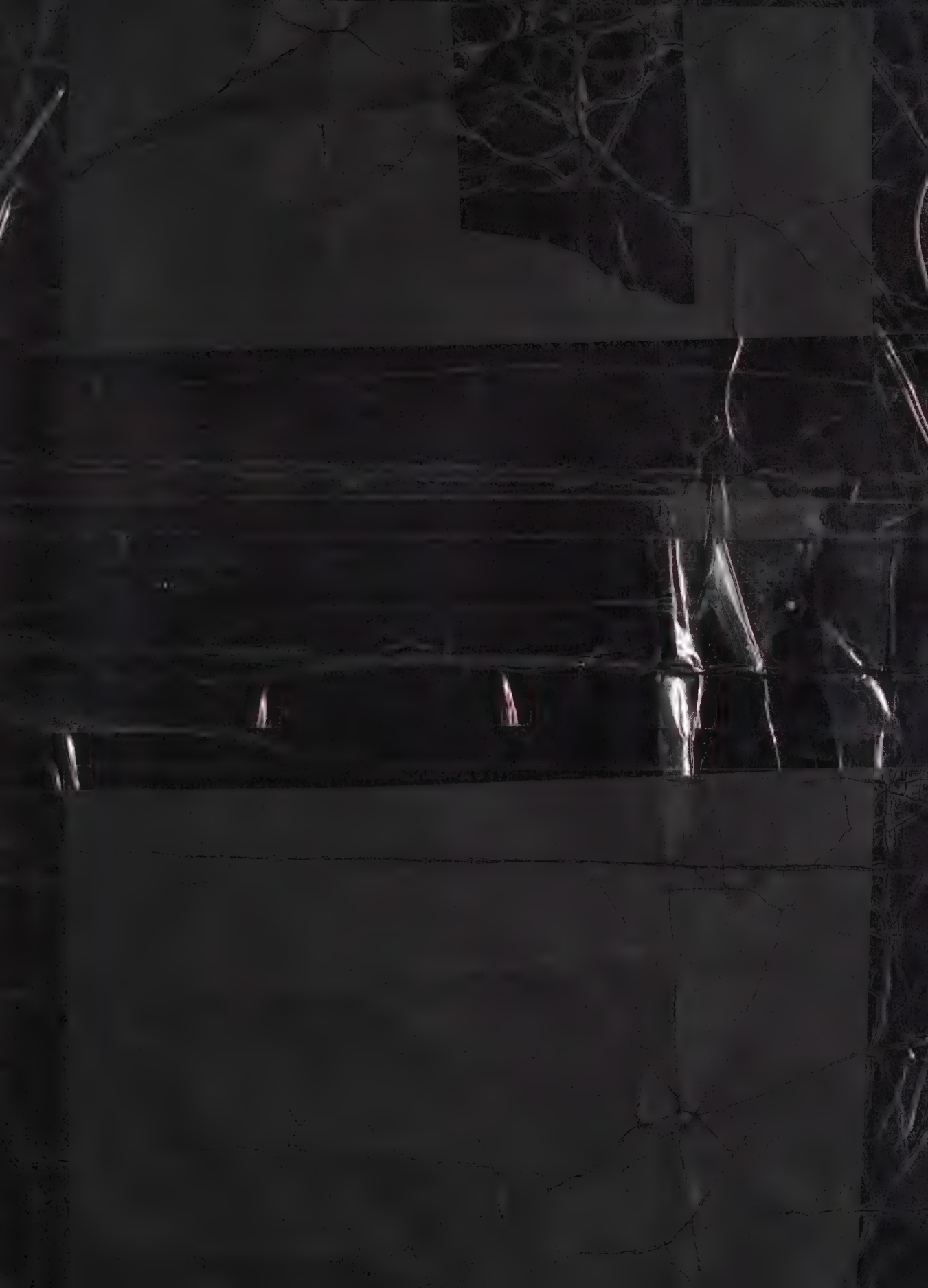


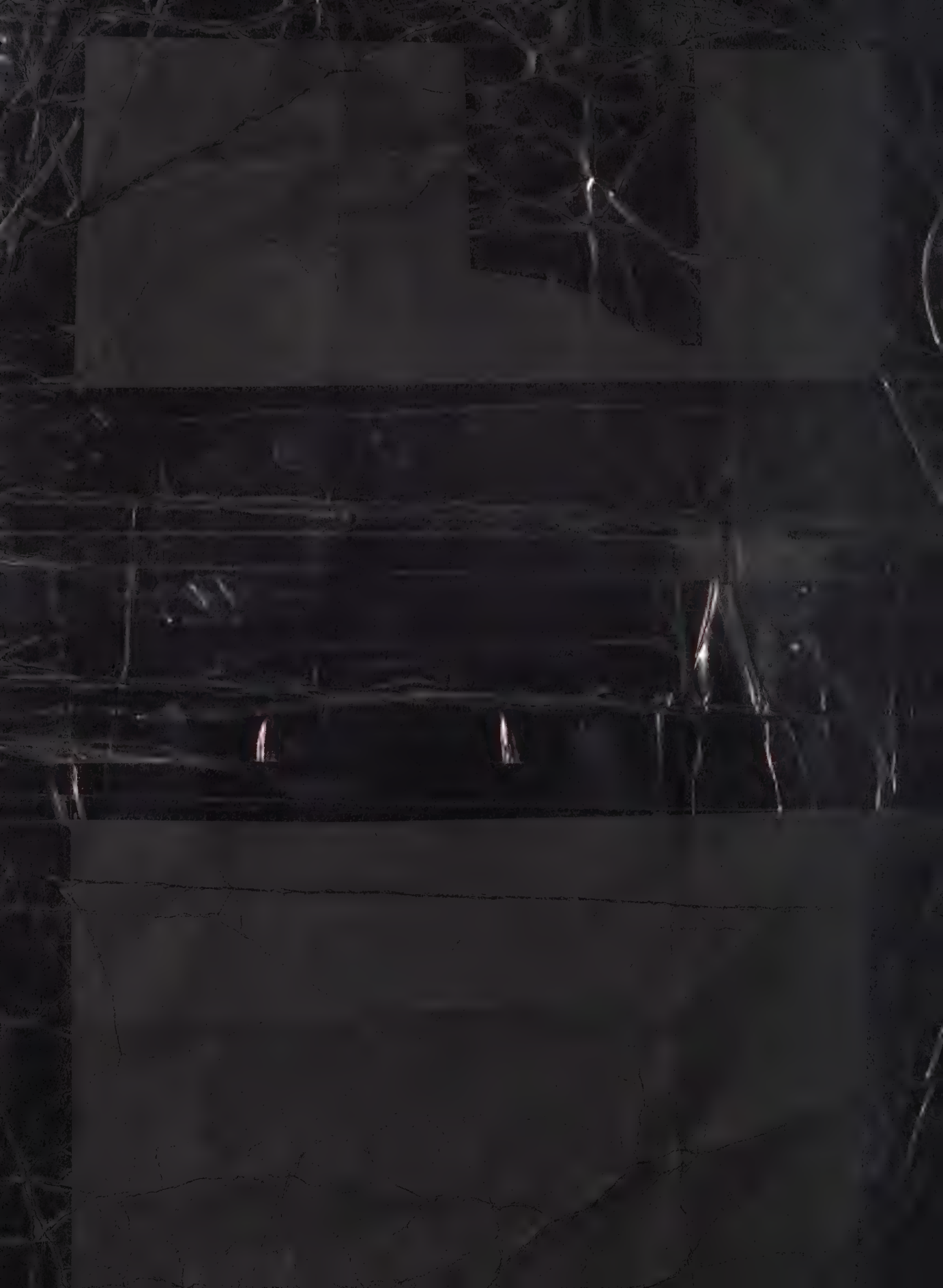
SCHEMATIC OF CIRCUIT

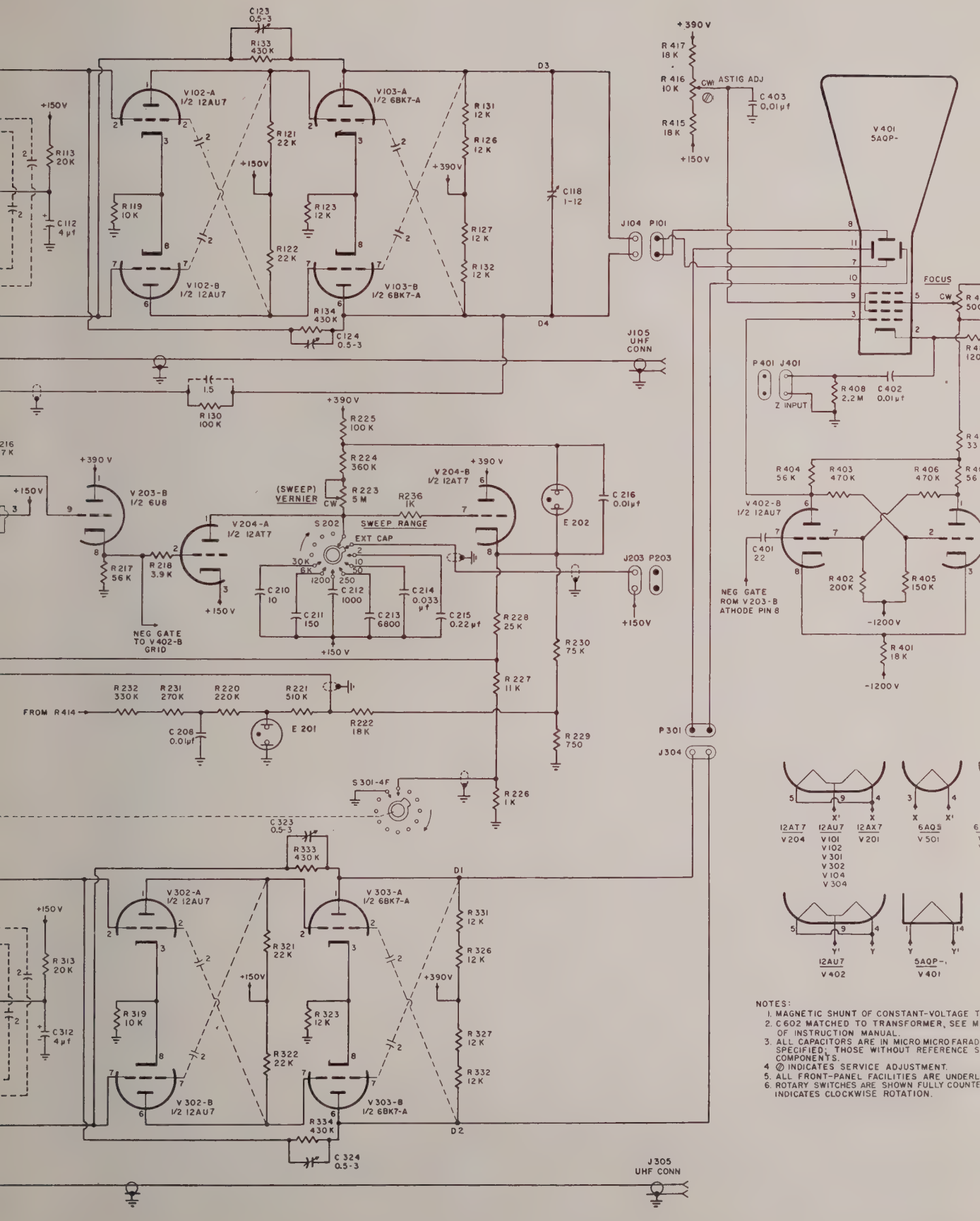
DU MONT TYPE 340 CATHODE-RAY OSCILLOGRAPH

Ref. Drwg. 98000901-4, Issue 10


Y SELECTOR
Y INPUT
J101
J102
FOR BALANCED INPUT REMOVE LINK
J103
S101-2R
S101-2F
S101-1R
A-C
D-C
COAX
OFF
C101 0.1µf
R101 2M
C105 1-12
C106 1-12
C125 0.01µf
R102 240K
C102 47
R103 20K
C103 820
R143 1K
R105 2M
R106 2M
R144 1K
C108 0.01µf
R107 220K
C109 0.01µf
R108 220K
C126 0.01µf
R145 1K
V 104-A 1/2 12AU7-Y
V 104-B 1/2 12AU7-Y
R135 1.8K
R110 1K
R136 1.8K
R137 10K
R138 82
Y D-C BAL
AMPLITUDE
V 101-A 1/2 12AU7-Y
V 101-B 1/2 12AU7-Y
R141 220
R139 1.5K
R142 220
Y POSITION
R120 1K
RG-59/U
TEST SIG
J202
EXT SYNC
J201
S 201
SYNC SELECTOR
INT
LINE
EXT
R 201 390K
C 201 0.1µf
LINE SYNC FROM JUNCTION R 604 & R 605
V 201-A 1/2 12AX7
V 201-B 1/2 12AX7
R 205 10K
R 207 120K
C 203 0.47µf
C 202 0.05µf
R 206 200K
SYNC AMPLITUDE
R 202 2.2M
R 204 1.8K
C 204 0.47µf
R 203 82K
V 202-B 1/2 6U8
V 202-A 1/2 6U8
R 208 82K
R 209 4.7K
R 210 1.2M
C 207 47
R 211 1M
R 214 1M
R 215 1.2M
V 203-A 1/2 6U8
MODE
R 212 12K
R 219 330K
C 205 47
X SELECTOR
X INPUT
J301
J302
FOR BALANCED INPUT REMOVE LINK
J303
SWEEP REC
DR
S301-2F
S301-1R
S301-2R
S301-3F
S301-4R
C301 0.1µf
R301 2M
C305 1-12
C306 1-12
C325 0.01µf
R302 240K
C302 47
R303 20K
C303 820
R343 1K
R305 2M
R306 2M
R344 1K
C308 0.01µf
R307 220K
C309 0.01µf
R308 220K
C326 0.01µf
R345 1K
V 304-A 1/2 12AU7-Y
V 304-B 1/2 12AU7-Y
R335 1.8K
R310 1K
R336 1.8K
R337 10K
R338 82
X D-C BAL
AMPLITUDE
V 301-A 1/2 12AU7-Y
V 301-B 1/2 12AU7-Y
R341 220
R339 1.5K
R342 220
X POSITION
R320 1K
RG-59/U

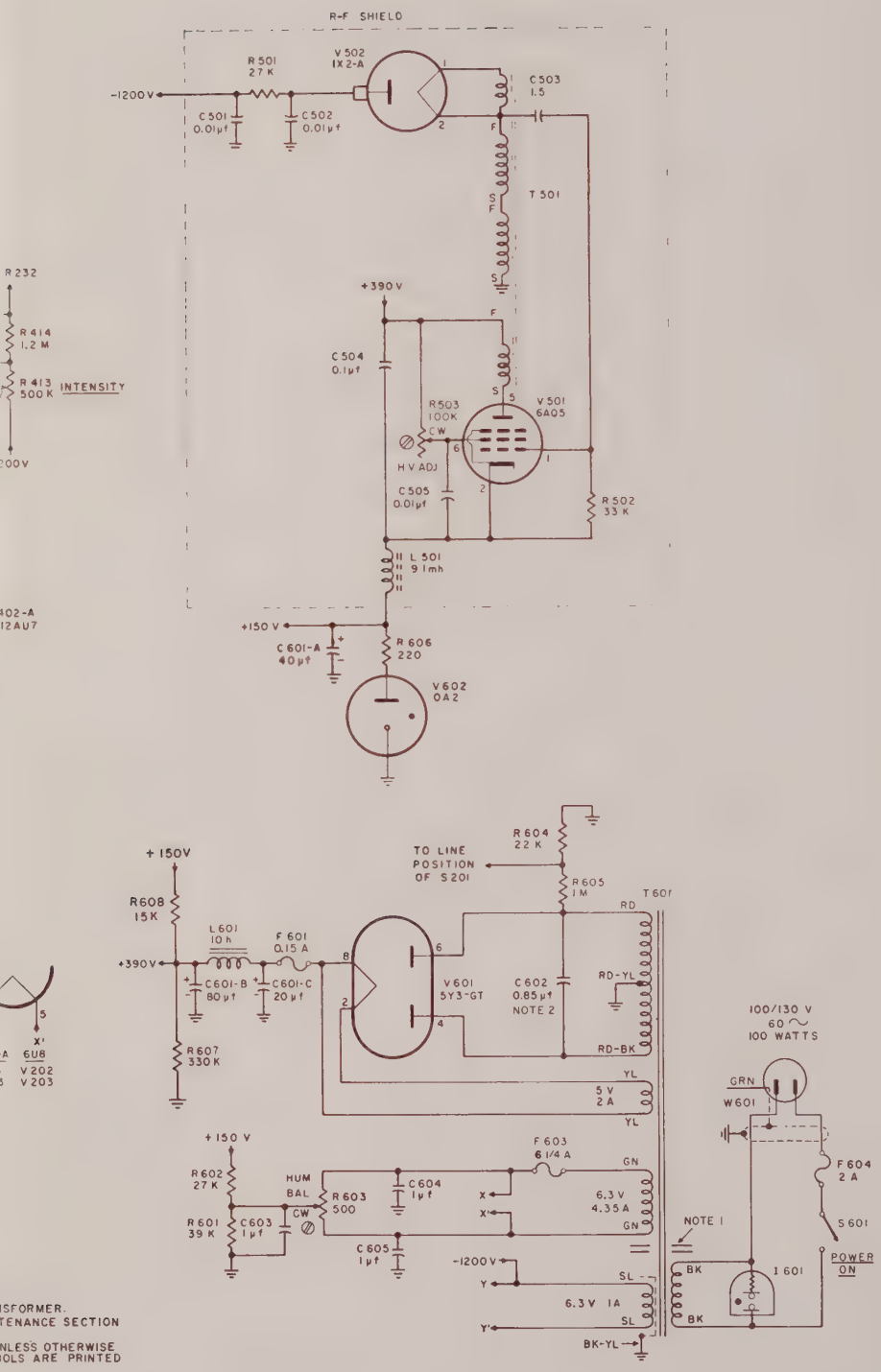






NOTES:

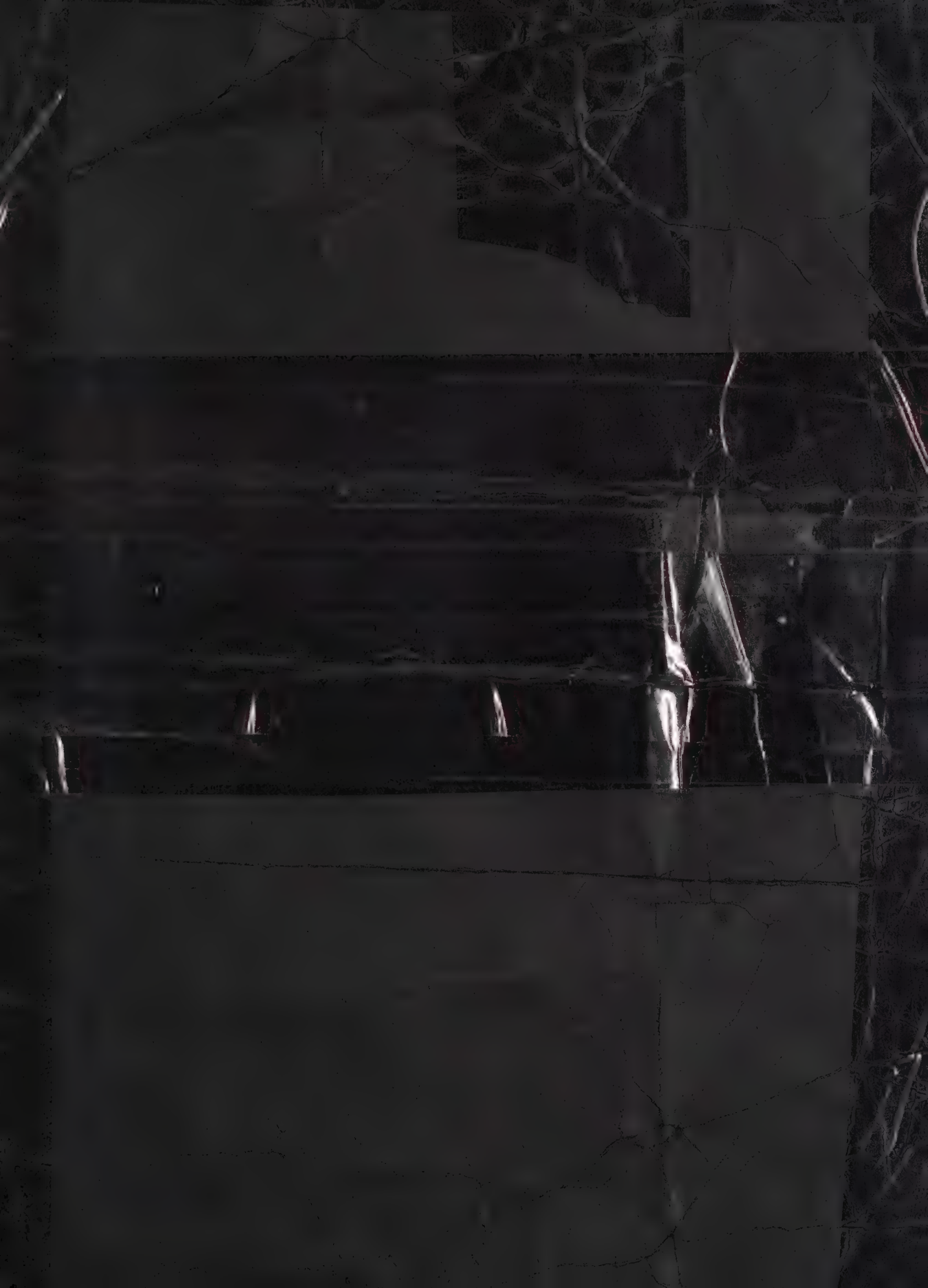
1. MAGNETIC SHUNT OF CONSTANT-VOLTAGE T
2. C 602 MATCHED TO TRANSFORMER, SEE M OF INSTRUCTION MANUAL.
3. ALL CAPACITORS ARE IN MICRO MICRO FARAD SPECIFIED; THOSE WITHOUT REFERENCE S COMPONENTS.
4. ⌀ INDICATES SERVICE ADJUSTMENT.
5. ALL FRONT-PANEL FACILITIES ARE UNDERL
6. ROTARY SWITCHES ARE SHOWN FULLY COUNTE INDICATES CLOCKWISE ROTATION.



SCHEMATIC OF CIRCUIT

DU MONT TYPE 341 CATHODE-RAY OSCILLOGRAPH

Ref. Drwg. 98000904-4, Issue 8



SCHEMATIC OF CIRCUIT

DU MONT TYPE 340 CATHODE-RAY OSCILLOGRAPH

Ref. Drwg. 98000901-4, Issue 10

WARRANTY AND SERVICE NOTICE
for
Industrial Type Cathode-ray Tubes and Instruments

DU MONT INSTRUMENTS

Each instrument manufactured by the Technical Products Division of Allen B. Du Mont Laboratories, Inc., is guaranteed to equal or exceed its published performance specifications. It is further guaranteed against defective materials (other than the cathode-ray tube) and workmanship for a period of one year from date of delivery. Any defective instrument or an instrument that does not meet or exceed our specifications will, upon inspection by us, be repaired or replaced at our discretion should such defect appear within the guarantee period.

To register this guarantee, the enclosed guarantee card must be properly filled out and mailed to the factory immediately upon receipt of the equipment. Complete information is necessary. BOTH THE TYPE NUMBER AND THE SERIAL NUMBER OF THE INSTRUMENT MUST BE GIVEN ON THIS CARD.

Instruments must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

DU MONT CATHODE-RAY TUBES

Industrial type cathode-ray tubes manufactured by Allen B. Du Mont Laboratories, Inc., are guaranteed for 1000 hours of operation or for a six-month period from date of shipment, whichever expires first. Adjustments will be made on the merit of each individual claim because of the widely varying applications to which such tubes are subjected, and a tube which becomes defective during the guarantee period will be replaced ONLY AFTER INSPECTION AT THE FACTORY. Cathode-ray tubes which are sent in under the guarantee, must be sent with transportation paid.

BURNED OUT HEATERS AND BROKEN GLASS ARE NOT COVERED BY THE TUBE GUARANTEE

To register a tube guarantee, the guarantee card enclosed with the tube must be properly filled out and mailed to the factory immediately upon receipt of the equipment. Complete information is necessary. TYPE NUMBER AND SERIAL NUMBER OF THE CATHODE-RAY TUBE MUST BE INCLUDED. The serial number of the tube will be found either on the glass stem of the electro-gun structure or on the bulb near the Du Mont brand. Tubes must be examined immediately upon receipt, since claims for damage in transit will not be honored by the carrier unless prompt action is taken.

CHANGES IN SPECIFICATIONS

The right is reserved to change the published specifications of equipment at any time and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications excepting under the classification of special apparatus.

SERVICE

In order to insure factory service under our guarantees, the guarantee cards enclosed with all instruments and tubes must be properly filled out and returned. In all cases where service or adjustment is requested, please write first to the factory giving complete information concerning the nature of the failure and describing the manner in which the equipment was used when failure occurred. THE TYPE NUMBER AND SERIAL NUMBER of the equipment must also be given. In this way, much time can be saved and unnecessary inconvenience often avoided. When writing in this respect, address:

Allen B. Du Mont Laboratories, Inc.
Technical Products Division
760 Bloomfield Avenue, Clifton, New Jersey

The Technical Products Division will then send to the customer, the written procedure for sending the instrument back to the factory. All equipment should be packed and shipped in accordance with this procedure; and identification tags should be attached to each tube or instrument.

REPLACEMENT PARTS

If it is necessary to order a replacement component from the factory, always give the type number and serial number of the instrument and refer to the component by its symbol designation and description on the circuit schematic. This will help to expedite service.

DU MONT

Additional copies of this manual may be secured at a cost of two dollars each or twenty dollars per dozen copies; postpaid in the United States of America only.

Allen B. Du Mont Laboratories, Inc.

TECHNICAL PRODUCTS DIVISION

760 BLOOMFIELD AVENUE, CLIFTON, N. J., U. S. A.